Impact of Alternative & Augmentative Communication on the Utterance Length of Children with Limited Oral Language

By

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Abstract

Children with limited oral language due to developmental and language delays have difficulty with communication in their everyday lives. Their trouble with speech and/or language impacts their ability to socialize with peers and learn in the school setting. Most of the research on alternative and augmentative communication systems and oral language has focused on the language development of children with less than 20 spoken words. The focus of this study is on the use of Alternative and Augmentative Communication Systems to increase oral language for children with limited oral language. Limited oral language is defined as being able to speak more than 20 words and an MLU of 2 or less. These alternative systems aid in expression and comprehension of language through visual and auditory means. Three boys age three to six were enrolled in the study lasting three months per child in an overlapping timeframe. Using a multiple baseline design during a shared book reading experience, the participants were given access to an AAC system. During the first baseline, books were shared with the participants, but only expectant pauses were used. The second baseline condition was the same as the first, except the AAC system was present. Finally, during the intervention phase, this system was modeled and expectant pauses were used. All participants demonstrated an increase in oral language as measured by mean length of utterances. However, since two of the children had high incidences of echolalia, it is difficult to ascertain if this increase was due to imitation or increased spontaneous oral language.

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Chapter 1: Introduction

Children with developmental delays can exhibit problems with language development. For example, many children with Autism Spectrum Disorders (ASD) and global developmental delays exhibit significant delays in language (Binger & Light, 2008; Mirenda, 2003). For children who have less than 20 words, various studies have demonstrated the benefit of AAC for speech and language development (Bellon-Harn & Harn, 2008; Binger & Light, 2008; Millar, Light & Schlosser, 2006; Romski & Sevcik, 1995). However, few studies have examined the effect of AAC on children who have more than 20 words and low MLU. These children may have some speech, but are developmentally delayed in their oral language. Examining such children who had more than 20 words would provide a better understanding of the effectiveness of AAC for this group in which there has been little study. The use of AAC helps children increase their exposure to language by scaffolding their language comprehension, and by providing more communication opportunities (Howlin, Goode, Hutton, & Rutter, 2004; Kaiser & Roberts, 2010; Ward, 1999).

AAC is an umbrella term that describes various unaided (e.g., American Sign Language and Signed Exact English) and aided (e.g., symbols and objects with low-tech systems or high-tech speech generating devices) techniques and approaches to facilitate communication (Beukelman & Mirenda, 2014; Binger & Light, 2007).These systems can either augment existing speech—for example, for children who are highly unintelligible—or replace oral language for children who are minimally verbal (Bellon-Harn & Harn, 2008; Drager, Postal, Carrolus, Catellano, Gagliano, & Glynn, 2006; Romski & Sevcik, 1995). A wide variety of AAC systems are available to meet the needs of the children who rely on them.

The purpose of this study was to examine the effectiveness of AAC use for children who can combine two words in oral language production. It poses the following question.

1. Does training children with expressive language disorders to use AAC increase the children's use of longer spoken utterances, as measured by mean length of utterances?

Chapter 1will review and explicate some of the available literature regarding the use of AAC for children with oral language delays, thereby providing a framework for exploring methods that aid these same children. The specific areas addressed are: (a) AAC, speech, and language development; (b) MLU and AAC; and (c) interventions used to implement AAC in the natural environment; (d) gaps in the literature.

Chapter 2 reviews the methodology used for the intervention using the AAC system in a shared book reading context. This chapter describes the participants, research design, measures and materials used. Reliability and treatment fidelity are also discussed.

Chapter 3 reviews the results. This includes the results for MLU in three phases: baseline phase, baseline with AAC phase, and the intervention phase. Standard Mean Deviation, and Tau-U scores are reviewed, as well as the multiple baseline graphs for the participants.

Chapter 4 discusses the implication of the results, limitations of the study and future research. Further discussion on the current study and its relation to the extant literature base is also covered. Lastly, conclusions of the current study are reviewed.

AAC, Speech, and Language Development

Although it has been acknowledged that AAC has a direct impact on speech and language development, the reasons remain unclear. Some researchers have theorized that the AAC system provides immediate feedback and a model for individuals who are using it (Romski & Sevcik, 1996). Some contend that by taking away the emphasis from oral language, AAC facilitates and

supports spontaneous oral language production (Blischak et al., 2003; Romski & Sevcik, 1996; Romski & Sevcik, 2005). Others emphasize that the use of AAC facilitates turn taking between the child and their communication partner, thus increasing communication opportunities (Kent-Walsh, Binger, & Hasham 2010). Whatever the reason, AAC systems provide a means to communicate, increase the number of opportunities to communicate, and increase a child's overall conversational participation and turn taking (Blischak et al., 2003; Kent-Walsh, Binger & Hasham, 2010; Romski & Sevcik, 2005).

Some parents and professionals have expressed concerns that children given an AAC system will not learn to speak. However, the results of different studies may suggest that AAC can be taught without having a negative impact on the child's oral language. (Bellon-Harn & Harn, 2008; Binger & Light, 2008; Charlop-Christy, Carpenter, LeBlanc& Millar et. al, 2006; Romski & Sevcik, 2005).

A meta-analysis by Millar et al. (2006) examined the impact of AAC on the oral language production of adults and children with developmental disabilities. The authors reviewed studies published between 1975 and 2003 and weighted the findings based on the rigor of each study. Together they demonstrated that 89% of the children and adults using AAC increased their oral language production, i.e., used more spoken words.

Schlosser & Wendt (2008) completed a systematic review of the literature base in order to examine the impact that AAC has on the oral language of children with ASD. The researchers focused on children diagnosed with ASDs. However, other concomitant diagnoses did not preclude inclusion in the study. The children exhibited no functional oral language. The studies had been accepted by a peer-reviewed journals, or approved as a dissertation or thesis, and were published between 1975 and 2007. The authors reviewed and organized the studies based on the

following characteristics: (a) participant characteristics, (b) AAC approach used, (c) methods, (d) outcomes, and (e) levels of certainty (i.e., inconclusive, suggestive, preponderance, conclusive). The findings from this review demonstrated that there were overall improvements in the speech and oral language of children provided with AAC systems. However, the gains reported were modest.

Furthermore, AAC provides a conduit for learning, and increases educational opportunities (Bellon-Harn & Harn, 2008). Children who have higher levels of self-determination have been shown to have better post-secondary outcomes ymeyer & Schwartz, 1997). Furthermore, although the evidence base is still emerging, the conclusions of AAC's effectiveness support its use for children with limited oral language.

Morphology and AAC

Brown, (1973), identified the order of morphemes and age that most children acquire a variety of morphemes as well as stages of language development based on a child's mean length of utterances (MLU). Morphemes are defined as the smallest meaningful linguistic unit whereas mean length of utterance measures, in this study, the average length of utterances using morphemes. As children learn language they put together longer sentences, which include more morphemes. For example, a one year old may only say about one word at a time (MLU of one) while children of about four use an average of four morphemes (Pence, Turnbull & Justice, 2012).

Bruno and Trembath (2006) worked with children who were given AAC systems with multiple symbols. The children in this study were diagnosed with cerebral palsy, apraxia, and Down syndrome. Adults modeled the use of symbols. Bruno and Trembath expanded on the child's use of the AAC system by repeating the symbols the child had just used and then adding

on an additional symbol. Therefore, Bruno and Trembath modeled longer utterance length using the AAC system. Modeling of longer utterances helped the children put together longer messages, resulting in increased MLU for symbols used on the AAC system. These results suggest that AAC influences a student's MLU. The researchers noted that the utterances produced by the children were given after a model. Therefore, the graduate students would enter an utterance in the system and then the child would enter the same utterance. This research seems to demonstrate that if more complex sentences with longer MLUs are modeled for the children, then they are more likely to express themselves using longer utterances when using AAC, but whether the children can then independently use utterances previously modeled is unclear. Nonetheless, modeling of AAC for the children supports modeling of symbol construction as an effective strategy in teaching children how to combine symbols. Although, in this case, it is not known if the children were able to then independently formulate longer utterances on their own.

Other research has demonstrated the effectiveness of modeling as an intervention strategy for children using AAC (Kent-Walsh, Binger & Hasham, 2010; Romski, Sevcik, Cheslock and Barton, 2006). One study which focused solely on children diagnosed with ASDs, (Checkley et al., 2012), assessed the relationship between AAC and MLU with three boys. All three boys were between 11 and 12 years of age with severe communication delays. Children video recordings and staff diaries were examined before and after AAC systems were introduced. Their results suggested a relationship between increased MLU and use of the SGDs, however there were no experimental controls in this study.

In light of the currently available research and the need for further support for strategies that improve MLU, research needs to be conducted to further establish how AAC can be used to

support children MLU increases. In particular, there needs to be more research on the impact of AAC on MLU in children who have limited oral language (more than 20 words)

Interventions to Implement AAC in the Natural Environment

Modeling, scaffolding, and augmented input are three strategies commonly used to teach children how to use AAC. The evidence base clearly supports the efficacy of these interventions in assisting children with complex communication needs to learn how to use AAC. Romski, Sevcik, Cheslock and Barton (2010) define modeling as when an adult communication partner demonstrates the correct use of symbols on an AAC system. For example, an adult may model the use of one or more symbols while also speaking a phrase related to the symbol or symbols they are modeling. In this manner, the student increases their receptive understanding of what has been modeled, which supports language growth.

Scaffolding is the use of prompts and models to aid in language development. Scaffolding provides a cue for the child so that he or she knows when to respond during a communication interaction (Bellon-Harn & Harn, 2008; Bruno & Trembath, 2006). For example, some clinicians use a small flashlight to highlight a symbol, so that the child will use the symbol. Increased communication opportunities occur when the adult models the use of the system and when they scaffold its use by pointing out the symbol they want the child to pick. For children who are only using one or two words at a time, a system of scaffolding may aid them in increasing their use of language by assisting them in constructing longer utterances (Bellon-Harn & Harn, 2008; Bruno & Trembath, 2006).

Augmented input is the deliberate use of the AAC system by communication partners while they are speaking with a child. Communication partners speak and model the use of the child's AAC system at the same time (Bruno &Trembath, 2006). For example, the

communication partner might model the phrase “the red balloon goes up” on the student’s Speech Generating Device (SGD), when they are reading about a red balloon in a book. In general, the communication partner will model the AAC system across contexts and for multiple communicative functions (Bruno &Trembath, 2006). Language comprehension and expression are then scaffolded by providing a visual cue and prompt so that the student is able to learn where symbols are located on their systems (Bruno &Trembath, 2006). This increases the child’s receptive understanding of AAC (Drager, Postal, Carrolus, Castellano, Gagliano, & Glynn, 2006; Drager, 2009).

Binger & Light (2007) implemented the use of modeling with five children who already used AAC systems. The purpose of the study was to examine the effect of modeling on the child’s production of multiple symbol messages. The children were between the ages of three and five and significantly unintelligible to unfamiliar communication partners, as measured by the Index of Augmented Speech Comprehensibility Development Inventories (Dowden, 1997). Furthermore, the children used only one word 90% or more of the time. Yet they all verbalized at least 25 words/symbols. The children enrolled in this study were diagnosed with Prader-Willi syndrome, Down syndrome, and developmental disabilities.

A multiple-probe design was used across all participants. The study consisted of five phases: baseline, instruction, generalization without aided AAC models, generalization with aided AAC models, and maintenance. During the intervention phase the researcher modeled the use of two symbols. A minimum of 30 models was demonstrated for each session. Later during the generalization phase the researcher did not model the use of the AAC system. However, if the child did not produce at least 12 multiple symbol messages, then they were provided additional instruction with modeling during the generalization with modeling phase. Procedural

reliability and inter-rater reliability were used to increase the rigor of this study. Four of the five children in the study increased their use of multi-symbol messages using modeling. Furthermore, the four children who used multiple symbol messages continued to use multi-symbol messages two months following the end of the study (Binger & Light, 2007). This study indicates that the use of modeling of multiple symbol messages can increase the child's use of multiple symbol messages. These children continued to use the multi-symbol messages used during the study, yet, they still needed explicit instruction to learn new multi-symbol messages (Binger & Light, 2007). This indicates that continued modeling is still beneficial, even after the child demonstrates the ability to combine symbols. It is possible the same may be true for children with limited oral language as well, that modeling may aid in increasing their MLU.

Romski and Sevcik (1996) used augmented input in a systematic fashion to show that children with moderate to severe cognitive disabilities can learn to communicate with AAC. All the children in their study made gains in communication, including verbal output and were able to generalize what they learned. Due to this research, Romski and Sevcik (1996) developed the System of Augmented Language input (SAL). This system uses modeling, and scaffolding via augmented input to help increase the communication skills of children who use AAC.

The SAL system has five basic components that help support the speech and language development of a child using an AAC system. First, the children are provided with SGDs; second, an appropriate system of symbols is used; third, intervention happens during the child's everyday routines in their natural environment; fourth, communication partners are trained to integrate the use of the AAC system with their spoken language (augmented input); and fifth, a system of ongoing monitoring is used to assess progress and monitor any difficulties that are

experienced by the child using the AAC system or the adult implementing SAL (Romski & Sevcik, 1996).

Further research went on to examine the effect of modeling (augmented input) and prompting (augmented output) for children using SGDs (Romski, Sevcik, Adamson, Cheslock, Smith, Barker & Bakeman, 2010). This study examined the effect of AAC use on language development. Participants were 62 children between the ages of 24-36 months, diagnosed with language delays, and with a spoken vocabulary of less than 10 words. One group used Augmented Input (AI). AAC was modeled for the children in this group, but they were not prompted to use the AAC system. A second group used Augmented Output (AO). Again, the AAC system was modeled for the student, but they were prompted to use their AAC systems. The third group focused solely on learning to verbalize. All of the interventions involved parent training and involvement. Both augmented groups demonstrated a larger gain in target vocabulary words than the speech-only group. Furthermore, when AI was compared with AO, children who were in the latter group performed significantly better than those in the former group. In other words, those children who were prompted to use their AAC systems gained more vocabulary compared to those children who only received a model.

As important as these interventions were, the context in which they were delivered is also another important consideration. For example, SAL specifies that interventions be used in a naturalistic setting (Romski & Sevcik, 1996). A naturalistic setting can include play, (Drager et al., 2006) mealtime (Romski & Sevcik, 1996), or during shared book reading (Bellon-Harn & Harn, 2008). For this study, I chose to use shared book reading as the context for the intervention.

Shared Book Reading and AAC

Shared book reading has been shown to enrich language for typically developing children and for children with language delays (Hargrave & Sénéchal, 2000). For children who require AAC, shared book reading increases language exposure (Kent-Walsh, Binger & Hasham, 2010). Shared book reading is an appropriate context for AAC intervention for the following reasons. First, language can be enriched. Words related to the books can be entered into the student's AAC system and the student can use this vocabulary to comment or ask questions on aspects of the story. Second, the child engages with the communication partner while they read. This interaction increases overall exposure to language, including pragmatic skills such as turn taking. Third, shared storybook reading provides a natural context for language intervention and further enhances the child's language development (Hargrave & Sénéchal, 2000; Kent-Walsh, Binger & Hasham, 2010).

A study by Bellon-Harn & Harn (2008) examined the use of AAC in a shared book reading context with a six-year-old girl who communicated primarily with single word utterances, but sometimes used two-word utterances to communicate requests (i.e., more cookie). The symbols on the system were exact copies of pictures taken from the books used during the shared book reading experience. Pre-programmed phrases were used with the symbols. There were two conditions. In the first condition, the researchers read a book and used scaffolding while reading. They read the book one time and then reread the book using scaffolding strategies such as asking wh-questions. In the second condition, they used the same procedure except they used an AAC system preprogrammed with questions and a choice of responses, so they could model both the question and the response.

In both conditions, the child increased her overall language skills as measured by spoken responses, responses using the AAC system, models of adult responses, number of utterances, child initiated responses, correct responses to questions, and off-topic utterances. However, the number of utterances was greater during the condition with the AAC system. Overall, both conditions supported the student's overall language development and assisted her in increasing her utterances. The researchers noted that there were less off-topic utterances when the child was using the AAC system. Finally, although this study did examine MLU (based on verbalizations) it appears that there was no significant change in MLU for this student.

In general, the research base has focused on the use of AAC to facilitate turn taking during shared book reading (Kent-Walsh, Binger & Hasham, 2010), on the specific strategies used during book reading (Liboiron & Soto, 2006) or recommendations for methodology when examining the use of AAC in a shared book reading context (Bedrosian, 1999).

Kent-Walsh, Binger and Hasham (2010) found that children whose parents used AAC with them during shared book reading used more semantic concepts and increased the number of turns after intervention than before. There were six parent child dyads enrolled in the study. There was a baseline and intervention phase. During the baseline phase, the parents read to the children as the typically would do at home. The AAC system was present but not modeled. During the second phase all parents were trained to use a three-step cueing hierarchy when reading to their children: 1) Read and provide an AAC model 2) Ask questions and provide a model with the AAC system and 3) Answer the question and model it with the AAC system. The results from this study indicate the use of AAC does facilitate turn-taking and communication between the parent-child dyads. All six children increased their turn-taking two-fold after intervention and also increased their use of vocabulary found within the books. Further research

on the use of shared storybook reading and AAC is warranted to help determine if shared book reading is an efficient context for increasing utterance lengths using AAC, as the direct impact of AAC on MLU was not explored.

Gaps in the literature

While several authors identify AAC as an aid to children with speech and language impairments, there is a lack of literature focusing on the acquisition of morphology for children who rely on such systems (McNaughton, Rackensperger, Benedek-Wood, Krezman, Williams & Light, 2008; Romski & Sevcik, 2005). There are no experimental investigations that examine the effect of AAC on increasing a student's complexity of communication, specifically in MLU. Many studies focus on using the AAC systems to establish a means of communication, but how these systems can increase the depth and breadth of a student's communication still needs further exploration (McNaughton et al., 2008; Romski&Sevcik, 1996; Romski&Sevcik, 2005).
There is no research examining the effects of AAC on MLU, for children who are using one to two-word utterances. If AAC is beneficial for children who have less than 20 spoken words, could it also provide benefit to children who have more than 20 words? Many times, this group of children lacks access to AAC because they have some oral language. In addition, professionals or family members believe that the use of an AAC system will hinder their oral language development (Millar et. al, 2006). Given the existing research, it seems possible that the use of AAC, within the context of shared book reading can help this group of children increase their utterance length. The following hypothesis is proposed: The use of AAC in a shared book reading context will increase the ability to combine two or more words as measured by mean length of utterances in morphemes for children with limited oral language.

Chapter 2: Methodology

Participants

Participants were recruited using referrals from a local speech-language pathologist (SLP) in the Kansas City area. The SLP gave copies of flyers to prospective families. In addition, information was sent to a parent volunteer with the Autism Society of the Heartland. Parents interested in the study were provided with the researcher's contact information and either contacted the researcher by e-mail or via phone and asked the following screening questions. First, how many words does your child speak? Second, are they putting at least two words together? If the child met these screening criteria the parents were invited to have them assessed to see if they qualified for the study. A time to review the informed consent and evaluate their child was then arranged.

Out of the five participants evaluated, two did not meet the stated criteria. One participant used single words only, and had less than 20 words, while the other was quite verbal, with age appropriate expressive language. Ultimately, three male participants who ranged in age from 3 to 6 years old (mean=4 years 6 months old) participated in the study. All the participants were native English speakers and English was their primary language and none of the participants were bilingual. Two participants were diagnosed with ASD and one participant had developmental delays. See table 1 for more information.

Prior to finding participants, the proposed study was reviewed and approved by the University of Kansas Human Subjects Committee. Parents were all given consent forms which were reviewed with the researcher to ensure that parents understood the scope of the study and could give informed consent. Parents signed the consent forms before their participants were assessed or provided intervention.

Research Participant Demographics

Each participant met the following criteria: (a) 20 or more spoken words; (b) an MLU of two or less; (c) did not currently have a SGD, or had not used one consistently within the last three years; (d) vision and hearing within functional limits; (e) fine motor skills sufficient to use a touch screen device. All of the participants participated in a formal language assessment before they started the baseline to ensure they met the listed criteria. Each participant's Individual Education Plan (IEP) was reviewed to confirm the diagnosis. The participants in the study were all given pseudonyms. See table 1 for Participant Demographics. All participants were given two formal assessments to examine his receptive and expressive language. Each of these assessments is described in the Measures section. The first assessment was the PPVT-IV (Dunn & Dunn, 2007) and the second was the EOWPVT 3rd edition (Brownell, 2000).

Table 1: Participant Demographics

Participant	Age	Gender	Diagnosis	Ethnicity
Matthew	3 years 6 months	Male	YCDD	White
Peter	6 years 4 months	Male	ASD	White
David	5 years 7 months	Male	ASD	Hispanic

*YCDD is Young Child with Developmental Delay; ASD is Autism Spectrum Disorder

Matthew

Matthew was diagnosed with delays in speech and language development in his IEP. He was 3 years 6 months at the start of the study. He lived at home with his mother, father, a younger sibling, and an older sibling. He received speech language pathology services in the

early childhood setting with goals that focused on both speech and language development. His interests included cartoons, trains, and pets.

Matthew mostly spoke using one word, occasionally putting two words or more together. He was difficult to understand and used a small number of signs to assist with communication. Matthew was persistent in getting others to understand what he wanted and needed. He also pointed to indicate what he wanted.

On the PPVT-IV, Matthew earned a raw score of 62, which converted to a standard score of 106 and placed him in the high-average range. On the EOWPVT 3rd edition, he earned a raw score of 20 and a standard score of 77 which was more than one standard deviation below children his age. He said 32 words during the EOWPVT 3rd edition assessment. A language sample was also taken and his MLU was 1.49, which according to Brown's stages of language development is typical for children between 12-24 months (Brown, 1973). Matthew was 42 months at the start of this study, thus he demonstrated significant expressive language delays in comparison to his peers. Procedures used for conducting the language sample are presented in the methods section.

Peter

The second participant was a 6 year 4-month old boy, Peter. He was diagnosed with ASD, which was listed as his primary disability on his IEP. He lived at home with his mother and father and one fraternal twin brother who has not been diagnosed with ASD. He received speech language pathology services in the elementary school setting. His goals focused on language development and pragmatics. His interests included music, vehicles, and he really liked candy and desserts.

Much of his oral language was rote-memorized phrases, using carrier phrases such as “I want.” He also tended to repeat phrases spoken by his communication partner. His mother reported that up until about one year before the study was conducted his oral language was very minimal, but then he started talking more. His twin brother at times spoke for him. His mother inquired about getting an AAC system, but the school felt that the use of such a system would hinder his oral language.

On the PPVT-IV, Peter earned a raw score of 42 which converted to a standard score of 62. This put him more than two standard deviations below the mean for language comprehension. On the EOWPVT 3rd edition he earned a raw score of 27 and a standard score of 57. This placed him three standard deviations below the mean. During the assessment, he used 45 spoken words.

A language sample was collected and analyzed for this participant. His MLU was 1.85. However, many of his phrases were rote phases, such as “Daddy up,” and “Mommy up.” He was cued to use the “I want,” phrase by his mother or father. This resulted in a larger initial MLU during the baseline language sample. Using Brown’s stages of language development, his MLU was delayed. His MLU was similar to children between 12 and 14 months and at the start of the study when his chronological age was 6 years and 4 months (Brown, 1973).

David

The third participant was a 5 year and 7-month-old boy. He was diagnosed with ASD, according to his IEP. He lived at home with his mother and father. He had one younger sibling, who also had a diagnosis of ASD. He was receiving speech language pathology services in the preschool setting. His goals focused on language development, including receptive, expressive, and pragmatic language goals. His interests included video games, superheroes, and dinosaurs.

He attended well to spoken language and repeated phrases that he heard from peers and adults. He used some carrier phrases such as “I want,” “I hear,” “I see,” when prompted with the corresponding phrase by his mother. David previously used a communication book at school, which according to his IEP, he was no longer using. He typically used one-word responses to express basic wants and needs.

On the PPVT-IV, David’s raw score was 28 and his standard score was 64. This put him more than two standard deviations below the mean for vocabulary comprehension. On the EOWPVT 3rd edition he had a raw score of 32 and a standard score of 79which placed him more than one standard deviation below the mean. A language sample was collected and analyzed and his MLU was 1.34. According to Brown’s stages of language development, this was similar to MLUs exhibited by children between 12 and 14 months and at the start of the study he was 5 years and 4 months old (Brown, 1973). During the assessment, he could verbalize 41 different words.

Measures

Language Sample

A language sample was taken before the start of the baseline sessions. The language sample involved approximately 30 minutes of free play. The researcher asked open-ended questions and made comments in an attempt to elicit at least 50 utterances. This language sample was transcribed and analyzed for MLU in morphemes using Systematic Analysis of Language Transcripts (SALT) (Miller & Chapman, 2000). Only utterances that were spoken and intelligible were used to calculate the participant’s MLU. Utterances that were Independent or Modeled or Prompted were included in MLU calculations.

If the participant used the SGD this was also noted, but this information was not included in the MLU. If a participant used the SGD and then verbalized, the SGD was noted as one utterance and the verbalization was another utterance. For example, when Matthew hit the symbol for "not," he then stated the word "not". The two forms of were noted as separate utterances. Only spoken verbal utterances were analyzed using MLU.

Mean Length of Utterance (MLU) in morphemes was calculated for the pre-intervention and post-intervention language sample, as well as all of the sessions, and 10% of play sessions. MLU was used as the primary dependent variable throughout the study. MLU was calculated based on the concept of c-units. C-units consist of an independent clause with its modifiers (Milller and Chapman, 2000). C-units are one valid and uniform way to measure MLU in typically developing children. In this study, c-units are being used to provide a standard uniform measurement technique. (Heilmann, DeBrock, & Riley-Tillman, 2013; Nippold, Frantz-Kaspar, Cramond, Kirk, Hayward-Mayhew, & MacKinnon, 2015).

Each morpheme was counted one time, apart from names of characters (i.e., Minnie Mouse and ice cream) which were counted as one morpheme. If the participant answered in the affirmative or negative, such as no or yes, then these were counted as one morpheme and one utterance as per the instructions on c-units for the SALT program (Miller and Chapman, 2000). Utterances with only vocalizations were not included in the MLU analysis, including any possible morphemes. Examples of such utterances were when the participant yelled, did an imitation of a dinosaur sound, or was using unintelligible jargon such as "babababa." Neither the vocalizations nor the utterances were included in the MLU analysis.

Utterances were also coded based on whether the utterance was independent verbal, verbal modeled, or prompted (see table 2). Independent verbal responses were those that were

expressed verbally and independently. Verbal modeled responses were those responses that the participant repeated all or part of what the researcher just stated. The participants' responses after being asked a question were coded as prompted. MLU calculations included verbal modeled oral language (M), prompted oral language (P) and independent oral language (IV).

Standardized Measures

The Peabody Picture Vocabulary Test PPVT-IV (Dunn & Dunn, 2007) was administered to measure comprehension This assessment ascertained the participants' baseline level of vocabulary understanding (Dunn & Dunn, 2007). The PPVT-IV assessment consisted of four color pictures which were presented to the participants. The participants were asked to point to the picture after listening to a target word using the carrier phrase "show me." At the start of the test there were four training items to help demonstrate what was expected. The training items required the participants point to one picture on the page. For example, one item was a boy and the participants were asked to "show me the boy." After administering the training items, the researcher started on the stimulus items based on the participants' ages. The researcher started in the section for the participant's age and began asking each participant to show targeted responses in the same manner as they reviewed while doing the training items.

Basal criteria were established by eight consecutive correct responses. Even when the researcher started with a set that was one-year younger than the participants' current age, it was still necessary to go back another year for all three children to find basal criteria. A ceiling was established after six consecutive incorrect responses. Errors were then subtracted from the ceiling item to calculate a raw score. This raw score was then used to determine a standard score.

There were 12 items in each set and all 12 items were administered starting with the first item and going in order to the last item. Before moving forward, a basal set was established. The

participants needed to have one or zero errors in a set of 12 for the basal set rule. If the participants were unable to meet the basal rule, then a previous set of 12 was given until a basal was established. For example, if the participant was five years old but made two errors in the set of 12 marked as the start point for five-year old, he was then given the previous set of 12 items marked as the start for four-year old. A ceiling was then obtained after each participant produced six or more errors in a set. The assessment was ended after all items in a ceiling set were presented.

A raw score was then calculated as the number of errors subtracted from the last item in the ceiling set. For example, if the last item in the ceiling set was 72 and the participant made 22 errors, this gave a raw score of 50. The raw score was used to find the standard score located in charts in the manual based on the participant's age

The Expressive One Word Picture Vocabulary Test (3rd edition) (EOWPVT) was also administered. This assessment ascertained the participant's baseline level of expressive vocabulary (Brownell, 2000). This EOWPVT is similar to the PPVT-IV as the participant looked at colored pictures of stimulus items and was asked to name the items. For this assessment, there was only one stimulus item per page.

The participant was given the following instruction at the start of the assessment: "I am going to show you some pictures, and I want you to tell me the one word that names each picture." At the start of the assessment there were four training items. The following prompt was used unless otherwise noted: "What is this?" After the training items, the researcher started with sets that were one-year younger than the participants' current ages, to better establish a basal score. This was done because all three participants demonstrated difficulty with expressive

language and therefore would have difficulty establishing a baseline, if started at their chronological age. What now follows are the results for each participant of the study.

Preference Assessment

Parents were asked to fill out a copy of the Reinforcement Inventory for Children (Willis, LaVigna& Donnellan, 1991). This helped the researcher identify appropriate vocabulary for the participant's SGD. This inventory also identified the participant's interests for construction of the books to be used during the study. The reinforcement inventory consisted of lists and questions about how much a participant liked or did not like a targeted activity. For example, some potentially reinforcing events included items such as candy, or activities such as watching television. There were five levels of interest noted on the inventory: Not at all, a little, a fair amount, much, and very much. Items in the fair amount, much, and very much categories were used to determine subject material of the books used in the study.

Materials

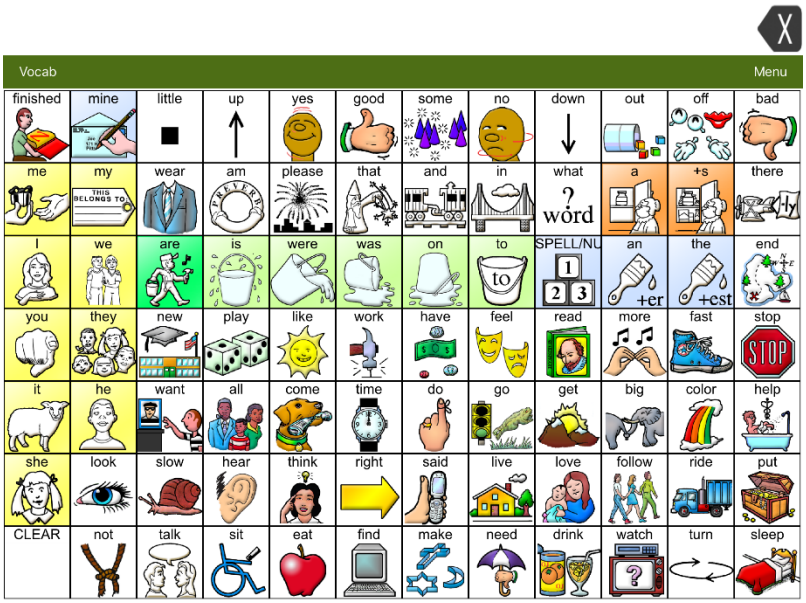
Vocabulary and organization of symbols for AAC system

Vocabulary for the AAC system included core vocabulary words and fringe vocabulary. Fringe vocabulary words are those words used less frequently, more personalized, and varied based on context, in comparison to core vocabulary which consists of words used with a high rate of frequency (Beuekelman & Mirenda, 2014). Appendix A lists all the vocabulary used in the AAC systems. Each symbol on the AAC system was linked with one word. Similar core vocabulary was used for all the AAC systems and all three participants. The words included a mix of nouns, verbs, adjectives, grammatical markers, and function words.

The AAC system used was the Words for Life application by the Prentke Romich Company. The main vocabulary system was LAMP 84 One Hit. This system included a set of

core vocabulary and fringe vocabulary with 84 symbols. This application was installed on two iPads. The symbols were organized using a modified Fitzgerald Key format, which was already organized in the Words for Life application (Fitzgerald, 1962). Modified Fitzgerald Key is a way to classify symbols on an AAC system using specific colors. Core nouns are yellow, core verbs are green, core adjectives are blue, and core function words are orange. Fringe vocabulary were words unique to each book added along the edges of the AAC system with white backgrounds. In the LAMP 84 system, only the most commonly used words in each category were colored. Figure 1 shows the LAMP 84 system used as the basis for the other systems.

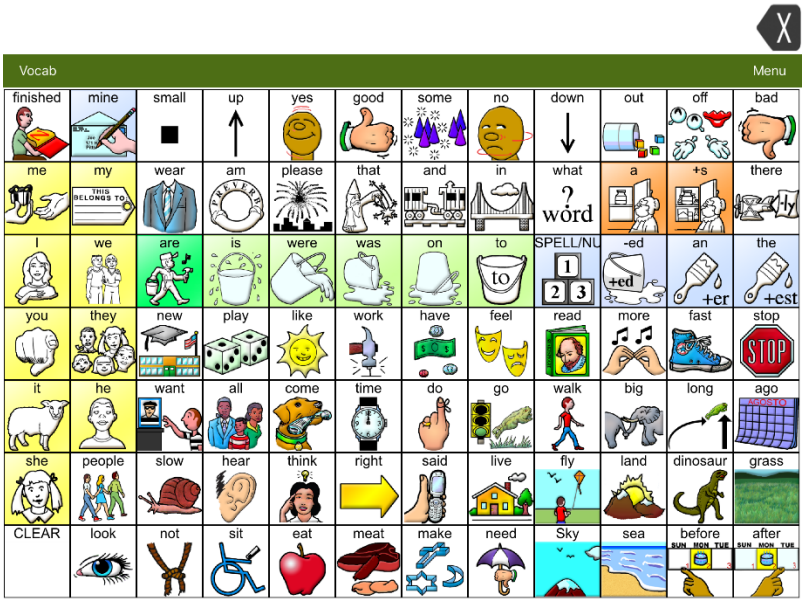
Figure 1*:* Core Vocabulary Board on iPad with 84 keys



Two grammatical markers were used, a plural –s and a past tense –ed, when these symbols were appropriate for the book. Finally, if a word used in the book was in a specific spot in the original symbol set, it was kept in the same spot for the symbol set used for the target book. For example, the word “big” is in the same spot in the symbol set made for the target book as it was in the original symbol set, which was LAMP 84.

Figure 2 is an example of what one participant's board looked like with the fringe vocabulary added for a target book. The target book was about dinosaurs.

Figure 2: Core Vocabulary with Fringe Vocabulary on iPad with 84 keys



Books

Three to four books per participant were written by the researcher using the Tarheel Reader platform (tarheelreader.org). This platform uses pictures that are in the public domain that do not have a copyright associated with them. Each of the pages contained one color or one black and white photo. The photo was borderless and contained images that were simple and uncluttered to reduce distractions. The photo also supported the text without adding any extraneous information. For example, for the picture of a dinosaur, a photo was used with little or no distractions in the background. This picture was also in color and had no borders along the edges. Figure 3 is an example of one image used.

Figure 3: Example of a Photograph

Each book was written based on the participant's interests as identified using the Reinforcement Inventory for Children (Willis, LaVigna& Donnellan, 1991). The books were nine to ten pages long. The text was nonfiction and discusses real world items, such as dinosaurs, or desserts, as well as aspects about those items (Price, Kleeck,&Huberty, 2009).

Each page consisted of written sentences between three and ten words long. The sentences were directly related to the image and did not require referencing to previous pages. In other words, the participant did not need to rely on information from the previous pages, but only needed to focus on the current page being read. In this manner, there was less of a cognitive load on the participant.

Research Design

This study investigated the impact of AAC on the oral language of participants who have limited oral language. For this investigation, limited oral language was operationally defined as being able to speak more than 20 words and an MLU of 2 or less. MLU was measured during a 20-30 minute language sample. MLU was also calculated for three stages: 1) Baseline sessions 2) Baseline with AAC sessions and 3) Intervention sessions.

The study used a multiple baseline across participants design. In multiple baseline across participants designs, control is demonstrated by showing that change occurs from baseline to treatment for each participant in a successive fashion. Importantly, baseline performance should remain stable until intervention is initiated for each participant in turn (Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf & Shadish, 2013). Also, many other studies in AAC have used multiple baseline designs or similar single subject designs and were able to demonstrate significant findings that informed practice (Bellon-Harn & Harn, 2008; Blischak et al., 2003; Charlop-Christy et al., 2002).

The researcher read a story from a book two times to the participant. The initial baseline condition did not include any form of intervention or use of the AAC system. The baseline with AAC condition included the AAC system, but without any modeling or use of the AAC system. Two baselines were included to help the researcher parse out any effect the use of AAC had on the MLU of the three participants in the study. The only time the AAC system was used was during the sessions with the researcher. The children did not have access to the systems outside of the sessions and did not have their own AAC systems.

The first baseline was six sessions long for the first participant, then two more sessions were added for the second participant. The third participant completed 14 baseline sessions, because he demonstrated an inconsistent initial baseline. Criteria for movement from the first baseline to the second baseline was a minimum of five data points and stable MLU across 3-5 sessions. Stability was defined as MLUs that were within .2 across sessions. Criterion for movement from the second baseline to the intervention stage was three stable data points. Intervention was discontinued when participants' MLUs were stable across 5 data points. This

indicated a plateau. Stability was measured using the same criteria as noted for the baseline session.

Baseline without AAC

During the sessions, the researcher's role was to read the books with the participant and to engage the participant in play after the shared book reading sessions. The researcher repeated what the participant stated, but did not expand on what the participant stated or use any other therapeutic techniques. Rather the researcher engaged the participant in conversation and followed the participant's lead. The AAC system was not present during the baseline sessions.

The researcher met the participant either at their home or in the clinic at the University of Kansas Medical Center in Kansas City, Kansas. She introduced herself to the participant and explained what they would be doing. The researcher described what they would be doing by stating that, "We are going to read a book together. I am going to read it two times."

First, the researcher read through the book one time. Then the researcher read the book again starting with the first page, paused for 3-5 seconds to allow the participant a chance to comment. If the participant did not comment on the page, the researcher commented about the page. Then the researcher waited for another 3-5 seconds for the participant to comment. If there were no response the researcher asked a question about the page. Again, the researcher waited 3-5 seconds for the participant to respond. If there was no response, the researcher moved on to the next page. At times, the researcher repeated comments and questions if the participant was clearly not attending to the book, or had left the room.

The following is an example of one conversation with David during the baseline sessions. This was taken during a shared reading session with the book: "What Did You Do at School Today?" E (Examiner) is the Researcher and C is the participant.

E: I colored some pictures. (Researcher reads from book and pauses.)

E: Look red crayon. (Researcher comments and pauses.)

E: What's that? (Researcher points to red crayon and pauses.)

C: %ahwhohah.

E: That's a crayon (Researcher answers own question, pauses and when there is no response turns the page and continues reading.)

E: I played outside. (Researcher reads from book and pauses.)

E: Look a slide. (Researcher comments and pauses.)

E: What's that Daniel? What's that? (Researcher points to the slide and pauses).

E: That's a slide.

Consistency was noted when the graph appeared flat according to visual inspection, and the participant's MLU varied by less than .2 MLU across successive data points.

Baseline with AAC

The researcher again met with the participant either in their home or in the clinic, as previously noted. The participant picked from three books, as in the baseline. The AAC system was present and opened to the target vocabulary for each book chosen. David was the only participant who used the AAC system during the baseline with AAC sessions.

In advance of the start of the baseline with AAC sessions, the researcher programmed the AAC system with the appropriate fringe vocabulary for each book. There was a set of pages unique to each book written. The participant was shown each of these vocabulary sets before the start of each book. The books provided were the same ones used during the baseline, except for one student who was given an additional book during this stage, as he had become bored with the previous selections. During the sessions, the AAC system was kept next to the participant or was

set between the participant and researcher. The researcher did not elicit use of the device during the baseline with AAC sessions.

The role of the researcher during the baseline with AAC sessions was similar to the baseline sessions. Other than showing the AAC system to the participant, the researcher did not use the AAC system. Furthermore, modeling of the AAC system did not take place. The researcher repeated what the participant stated, but did not expand on what the participant stated or use any other therapeutic techniques. Rather the researcher engaged the participant in conversation and followed the participant's lead. Moreover, this second baseline was included to rule out the influence the presence of an AAC system might have on the participant's oral language.

The researcher described what they would be doing by stating that, "We are going to read a book together. I am going to read it two times." For many children, the routine had already become quite familiar, so this explanation was not always used as the participant already knew the routine. The researcher and participant then read three books.

The following is an example of part of one session with David during the baseline with AAC sessions. In this example, David uses the SGD to respond. The book being read was entitled "Dinosaurs Lived Long Ago." E is examiner and C is the participant.

E: Dinosaurs lived long ago. (Researcher reads from book and pauses.)

(Participant does not respond.)

E: Look a dinosaur growling. (Researcher makes a comment and points at picture of a dinosaur.)

C: What some. (Participant uses SGD to respond.)

E: Some dinosaur's growl? (Researcher expands on what participant stated.)

C: No (Participant uses SGD to respond.)

E: No dinosaurs yell.

E. They roar. (Researcher responds to participant's comment).

C: No, No (Participant uses SGD to respond.)

If a participant protested and refused to participate in the session, the session ended and the researcher came back at a different time. When the participant simply hit the SGD randomly, the researcher verbally repeated what the participant chose, and then commented on the response. When the participant chose an off-topic symbol the researcher repeated it, commented on it and moved on to the next page. For example, when David first started activating the symbols he touched a symbol randomly. One time he touched the word bus. Then the researcher commented on the symbol by stating the word bus and commenting, that it was a bus. After commenting, the researcher moved on to the next page. Lastly, when the participant did choose a symbol on the SGD or commented verbally on topic, the researcher acknowledged what the participant chose or stated.

For all three participants, three data points were collected during the baseline with AAC stage (Kratochwill et al., 2013). This stage was shorter as the participants had already been at baseline for at least five sessions. After the three sessions, the intervention stage was started.

Intervention

The vocabulary sets used in the baseline with AAC condition were also used in the intervention sessions. The device was on hand and at the start of each book the participant was oriented to the AAC system. The device was kept next to the participant or between the participant and the researcher. At times, the participant held the device as well.

The role of the researcher was to encourage the participant to either verbally respond or to respond with the AAC system. The researcher modeled the use of the AAC system while reading the book. The researcher also expanded on what the participant stated by at least one morpheme and praised the participant's verbal communication and their use of the AAC system.

The researcher continued to meet with the participants either in their homes or in the clinic for a total of 81 sessions. The participant picked from four books including the three used in the baseline, but only three were read to the student. However, there was one exception where the student (Peter) transitioned from one book to another by having the researcher initially read four books during the session. This happened during the initial sessions with the new book, hence, a total of four books were read including the new book. Eventually the participant returned to reading three books.

The key difference between baseline and intervention is when the book was read the second time through, the researcher modeled the use of the SGD by selecting symbols. The researcher modeled a minimum of two symbols together. The researcher also verbalized what they were reading at the same time. Then the researcher waited 3-5 seconds for the participant to comment on the page. If the participant did not comment on the page, the researcher made a comment about the page and modeled the comment using the SGD. Then the researcher waited another 3-5 seconds for the participant to comment. After the participant commented, or if there was no response, the researcher then asked a question about the page incorporating the comment made about the page. Between each comment and after the question, the researcher paused for 3-5 seconds to allow the participant time to respond. The researcher then turned the page and repeated the same procedure until they were done reading the book.

An example of this interaction between the researcher and student during the intervention session follows. This was the second intervention session after the baseline with AAC sessions. In this interaction, the participant uses the SGD to respond and speaks. The comments made with the SGD are noted in brackets. The book is entitled “Dinosaurs lived long ago.” E is examiner and C is participant.

C No my turn.

E Dinosaurs lived long ago (Researcher uses iPad while reading and picks the symbols [Dinosaurs] [live] [-ed] [long] and [ago].)

C Here.

C [grass] (Participant hits [Grass] symbol.)

E Yes, they eat grass (Researcher reinforces and expands on participant’s utterance using the iPad and picking the symbols [They] [eat] [grass].)

C [grass]

E That’s right grass (Researcher reinforces and expands on participant’s utterance using the iPad and picking the symbols [They] [eat] [grass].)

E Dinosaurs ate grass. (Researcher reinforces and expands on participant’s utterance using the iPad and picking the symbols [Dinosaur’s] [eat] [-ed] [grass]. Picking the [-ed] turns [eat] to [ate].)

C [grass] (Participant picks the symbol [grass].)

When the participant responded with one symbol or word, the researcher expanded on the word by adding more symbols and utterances. For example, if the participant stated dinosaur, the researcher expanded what they stated by saying and modeling on the SGD “big dinosaur.” When the participant responded orally or with the SGD the researcher praised the participant and

acknowledged what the participant had said. All responses were praised whether single words or multiple words. This was to encourage the participant to speak. Furthermore, the researcher then expanded upon their response verbally while modeling the expansion using the SGD. For example, when the participant stated “piano,” the researcher expanded on this by stating “amazing piano,” both with oral language and using the SGD.

When the participant’s symbol selection was random or off-topic, the researcher verbally repeated the speech from the SGD, commented on the response, and moved on to the next page. If the participant selected an off-topic symbol then the researcher verbally repeated it, commented on it and continued to encourage participant to verbally respond. When the participant chose on-topic symbols or spoke, then the participant was praised and the researcher and participant moved on to the next page.

Play Sessions

After the researcher read three books with the participants, the researcher and participant engaged in about 15 minutes of free play. The purpose of the play sessions was to determine if the participant generalized any of the verbalizations or the use of the SGD outside the shared book reading context. The play sessions provided an opportunity in a naturalistic setting for the participant to demonstrate their ability to combine two or more words and to use the AAC system.

Throughout all three stages, the researcher followed the participants’ lead during play sessions. The books were put away and preferred toys were used. These toys included a farm set, dinosaurs, musical instruments, and simple games meant to engage the participant in conversation and play. The only time that the AAC system was present during the play sessions was after the start of the baseline with AAC phase and during the intervention phase. The role of

the researcher during the play sessions was to engage the participant in play and conversation. For the baseline and baseline with AAC phases, the researcher repeated what the child stated, but did not use therapeutic techniques, other than asking questions to encourage the child to speak.

Coding

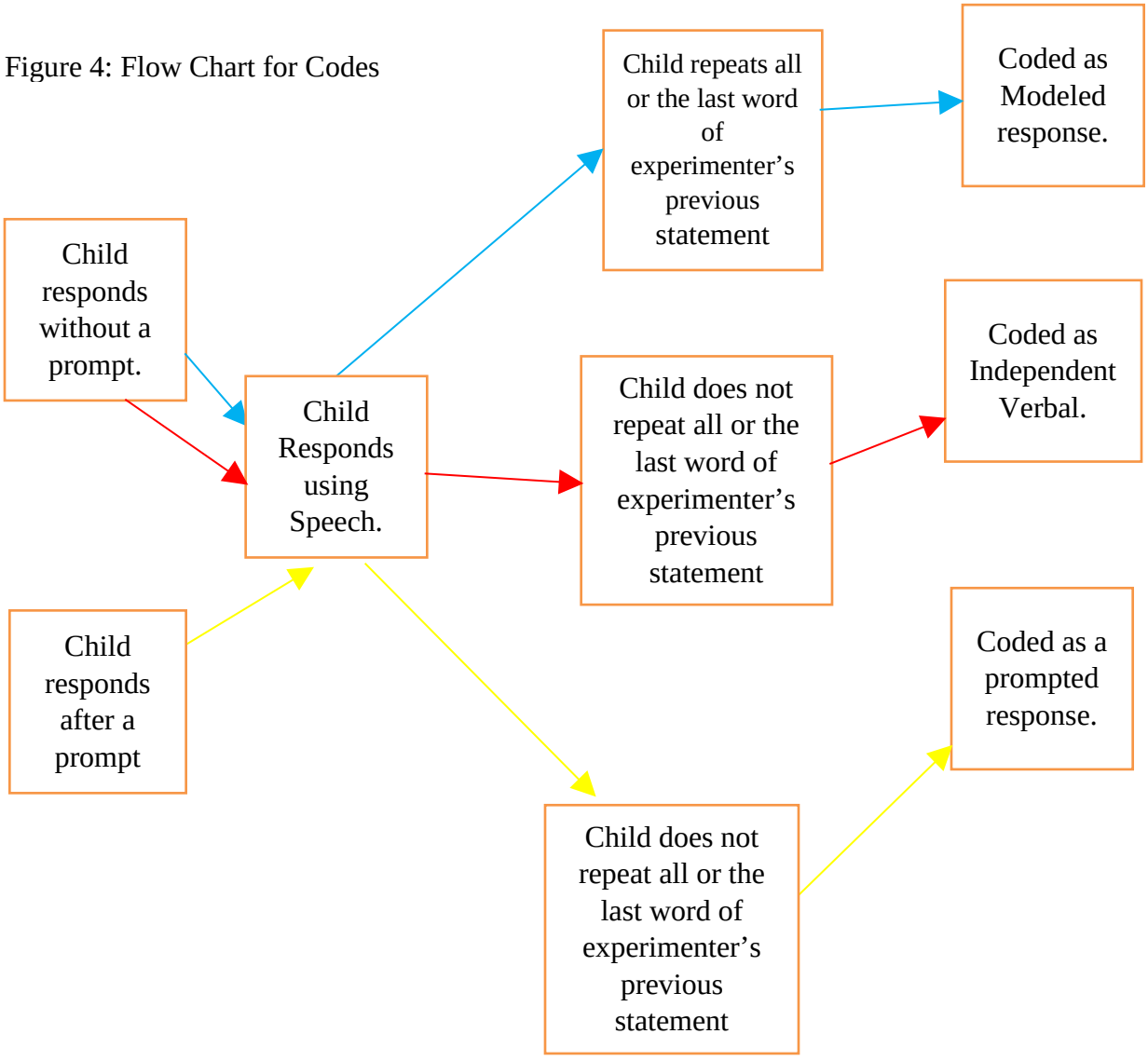
Each baseline and intervention session was videotaped and later coded by the researcher. The initial and final language samples were also coded in the same manner. Each child utterance was coded as *independent verbal*, *verbal modeled*, or *prompted.* In addition, codes were used to indicate utterances produced with an SGD or both oral language and SGD. Only utterances that were completely intelligible were coded. Unintelligible and partially unintelligible utterances were not coded. The unintelligible or partially intelligible utterances were excluded from the MLU calculations. It was difficult to note whether utterances partially intelligible or unintelligible were independent responses, responses after a model, or prompted responses, because the researcher was unable to understand what the child was saying.

Definitions for each code are presented in Table 2. IV stands for independent and verbal response, SGD for responses made with the SGD, M for a verbal modeled response, and P for a prompted response. All responses made with the SGD were noted, but not used in the overall calculation of the student's MLU. See Figure 4 for details regarding the decision-making process.

Table 2: Coding Definitions

Code	Definition
Independent verbal (IV)	When a child responded independently, verbally, without a prompt or model then the utterance was coded as independent and verbal.
Speech Generating Device (SGD)	When a child responded independently, with the SGD, without a prompt or model then the utterance was coded as SGD
Verbal Modeled (M)	When the child responded independently, and verbally after a model it was coded independent after model.
Prompted (P)	If the child responded to a question, then it was labeled as prompted.

Figure 4: Flow Chart for Codes



Reliability and Treatment Fidelity for Shared Book Reading Sessions

A graduate student in the Department of Speech Language Pathology and a Speech Language Pathologist (SLP) reviewed sessions for reliability and treatment fidelity. The graduate student transcribed 24% (17/71) of the shared book reading sessions and checked these sessions for reliability and treatment fidelity. The SLP did not transcribe any of the shared book reading sessions. However, she did review the sessions for treatment fidelity. In total 11% (9/81) of the sessions were reviewed for treatment fidelity by either the graduate student or the SLP.

Reliability for Shared Book Reading Sessions

The reliability between MLUs derived for each of the joint book reading sessions was measured with Pearson's R between raters. Pearson's R was .953 and included shared book reading sessions during baseline, baseline with AAC, and intervention sessions. This indicated a high consistency for the calculation of MLU between the graduate student and the researcher.

Treatment Fidelity for Shared Book Reading

The graduate student or experienced SLP simply picked from the available sessions that she was transcribing. She chose every third session. A copy of the procedures was provided to the student and SLP in a checklist format. They looked for (a) how often the researcher used the SGD, if applicable and (b) how often the researcher modeled the SGD if applicable during shared book reading and (c) how often the researcher used pauses between comments or questions and (d) how long the researcher paused between comments and questions. Protocols provided for the student and SLP can be found in table 3 for baseline sessions and baseline with AAC, and table 4 for intervention sessions.

A graduate student or an experienced SLP completed treatment fidelity sheets for 11% of the sessions. Treatment fidelity for the shared book reading sessions was also calculated. This was calculated using the treatment fidelity checklists in tables 3 and 4. Percent of yes and no responses were calculated for each book. Yes, responses were the preferred responses and the number of yes responses were divided into the total number of responses and a percent was found. For example, if nine out of 10 responses were yes, then the percent treatment fidelity was 90%. Treatment fidelity was 99% for the 27 books read over nine sessions across the baseline, baseline with AAC, and intervention phases.

Coding Reliability for Shared Book Reading

Inter-rater reliability for the codes applied to each utterance was calculated using Cohen's Kappa. Only the following three codes were included, IV for independent verbal, M for verbal modeled, and P for prompted. SGD was not included because the focus of this research was on the oral language of the children. Twelve sessions across three participants were used to calculate inter-rater reliability for the shared book reading. The Kappa for the shared book reading sessions was .48 across the baseline with a 95% confidence interval of .19 to .78, baseline with AAC, and intervention conditions. This indicates a moderate agreement between two coders (Cohen, 1960; Landes & Koch, 1977).

Reliability for Play Sessions

Only 20% (17/81) of the play sessions were transcribed by the primary researcher. Of these sessions, only 59% (10/17) of play sessions were independently coded by either the graduate student or the SLP. Play sessions of at least 10 utterances were chosen and transcribed. Each person transcribed the sessions they reviewed.

The reliability between MLUs derived for each play session was measured with Pearson's R. The reliability for the play sessions was .810. This reliability included shared play sessions during baseline, baseline with AAC and intervention sessions. Pearson's R indicated consistent transcription between the researcher and the other transcriber. (Either the graduate student or the SLP.)

Coding Reliability for Play Sessions

Inter-rater reliability for the play sessions was also calculated using Cohen's Kappa. Only the following three codes were included, IV for independent verbal, M for verbal modeled, and P for prompted. SGD was not included because the focus of this research was on the oral language of the participants. Eight sessions across three children were used to calculate inter-rater reliability for the play sessions. The Kappa for the play sessions was .58 across the baseline with a 95% confidence interval of .48 to .68. This indicates a moderate agreement between two coders.

Table 3: Procedural Fidelity Checklist for Baseline

Date:	Time:	AAC device present? **Y/N**	Child identifier:	Clinician:	Session#
Reliability Checklist: Please review the following procedures after the researcher has read through the book one time. Please mark yes or no for each row. Please note any words, AAC symbols or if they used both spoken and AAC symbols. Please use additional pages as needed.					
Page #		Page #		Page #	
Reads one page at a time.	**Y/N**	Reads one page at a time.	**Y/N**	Reads one page at a time.	**Y/N**
Pauses for 3-5 seconds after reading page	**Y/N**	Pauses for 3-5 seconds after reading page	**Y/N**	Pauses for 3-5 seconds after reading page	**Y/N**
If no response, makes a comment about page.	**Y/N**	If no response, makes a comment about page.	**Y/N**	If no response, makes a comment about page.	**Y/N**
Pause for 3-5 seconds after comment.	**Y/N**	Pause for 3-5 seconds after comment.	**Y/N**	Pause for 3-5 seconds after comment.	**Y/N**
If no response, asks a Wh question.	**Y/N**	If no response, asks a Wh question.	**Y/N**	If no response, asks a Wh question.	**Y/N**
Pause for 3-5 seconds after question	**Y/N**	Pause for 3-5 seconds after question	**Y/N**	Pause for 3-5 seconds after question	**Y/N**

Table 4: Procedural Reliability Checklist-Intervention

Date:	Time:	AAC device present? **Y/N**		Child identifier:	Clinician:
Reliability Checklist: Please review the following procedures after the researcher has read through the book one time. Please mark yes or no for each column. Please note any words, AAC symbols or if they used both spoken and AAC symbols. Please use additional pages as needed.					
Page #		Page #		Page #	
Reads one page at a time. Modeling vocabulary on SGD.	**Y/N**	Reads one page at a time. Modeling vocabulary on SGD.	**Y/N**	Reads one page at a time. Modeling vocabulary on SGD.	**Y/N**
Pauses for 3-5 seconds after reading page	**Y/N**	Pauses for 3-5 seconds after reading page	**Y/N**	Pauses for 3-5 seconds after reading page	**Y/N**
If no response, makes a comment about page. Modeling comment of SGD	**Y/N**	If no response, makes a comment about page. Modeling comment of SGD	**Y/N**	If no response, makes a comment about page. Modeling comment of SGD	**Y/N**
Pause for 3-5 seconds after comment.	**Y/N**	Pause for 3-5 seconds after comment.	**Y/N**	Pause for 3-5 seconds after comment.	**Y/N**
If no response, asks a Wh question. Modeling comment on SGD	**Y/N**	If no response, asks a Wh question. Modeling comment on SGD	**Y/N**	If no response, asks a Wh question. Modeling comment on SGD	**Y/N**
Pause for 3-5 seconds after question	**Y/N**	Pause for 3-5 seconds after question	**Y/N**	Pause for 3-5 seconds after question	**Y/N**
If no response moves to next page.	**Y/N**	If no response moves to next page.	**Y/N**	If no response moves to next page.	**Y/N**

Chapter 3: Results

The purpose of this study was to examine the impact of AAC on the oral language of children with language delays. Three boys participated in this study. Their spoken MLUs were calculated and each utterance was assigned one of three codes: IV (Independent Verbal), M (Verbal Modeled), or P (Prompted).These codes described the nature of the child's utterance. A multiple baseline design was used to examine the impact of AAC on the child's overall MLU measured in morphemes. Only intelligible and spoken utterances were used to tabulate the results. AAC use was not included in the child's MLU calculations.

MLU and AAC

During the baseline and baseline with AAC phases the participants' MLUs remained steady. As shown in Figure 5, each participant's MLU gradually increased after the intervention began. However, as noted, one participant did have a rising baseline at the end of the baseline with AAC condition. Still, after the start of intervention his MLU again dropped and then gradually increased. Overall, there appears to be an increase in MLU after the start of intervention for the participants.

Kratochwill et al. (2013) noted that the following six features were important to gauge the results of multiple baseline studies; (a) level, (b) trend, (c) variability, (d) immediacy of the effect, (e) overlap, and (f) consistency of data patterns. The researcher of this study examined the overall visual trend of each phase of the study in order to determine how well each of these criteria were met.

Level

During the baseline and baseline with AAC stage the MLUs for the first three children remained level. In other words, the means for the baseline and baseline with AAC conditions remained stable (change in MLU < 0.2) for all three children. After the intervention was started the mean MLU increased after three to five sessions depending on the participant, and was therefore no longer level. This is one possible indication that the intervention impacted the student's MLU.

Trend

During the baseline with AAC phase, the slope for two of the three participants was flat, except for one student who had a negative slope in the initial baseline. This stabilized after the baseline was extended. He also had a rising baseline at the end of the baseline with AAC stage. Conversely, after the start of the intervention, the trend for all three participants had an upward appearing slope in the baseline and baseline with AAC phase. The trend for two of the three participants was neutral.

Variability

The variability of the first two participants MLU was consistent upon visual examination for the baseline and baseline with AAC phase. However, the third participant's MLU encompassed a wider range of variability in the initial baseline stage than the previous two participants. That is the main reason that this participant was kept in baseline longer than the first two children. Again, the variability stabilized after the baseline phase was extended.

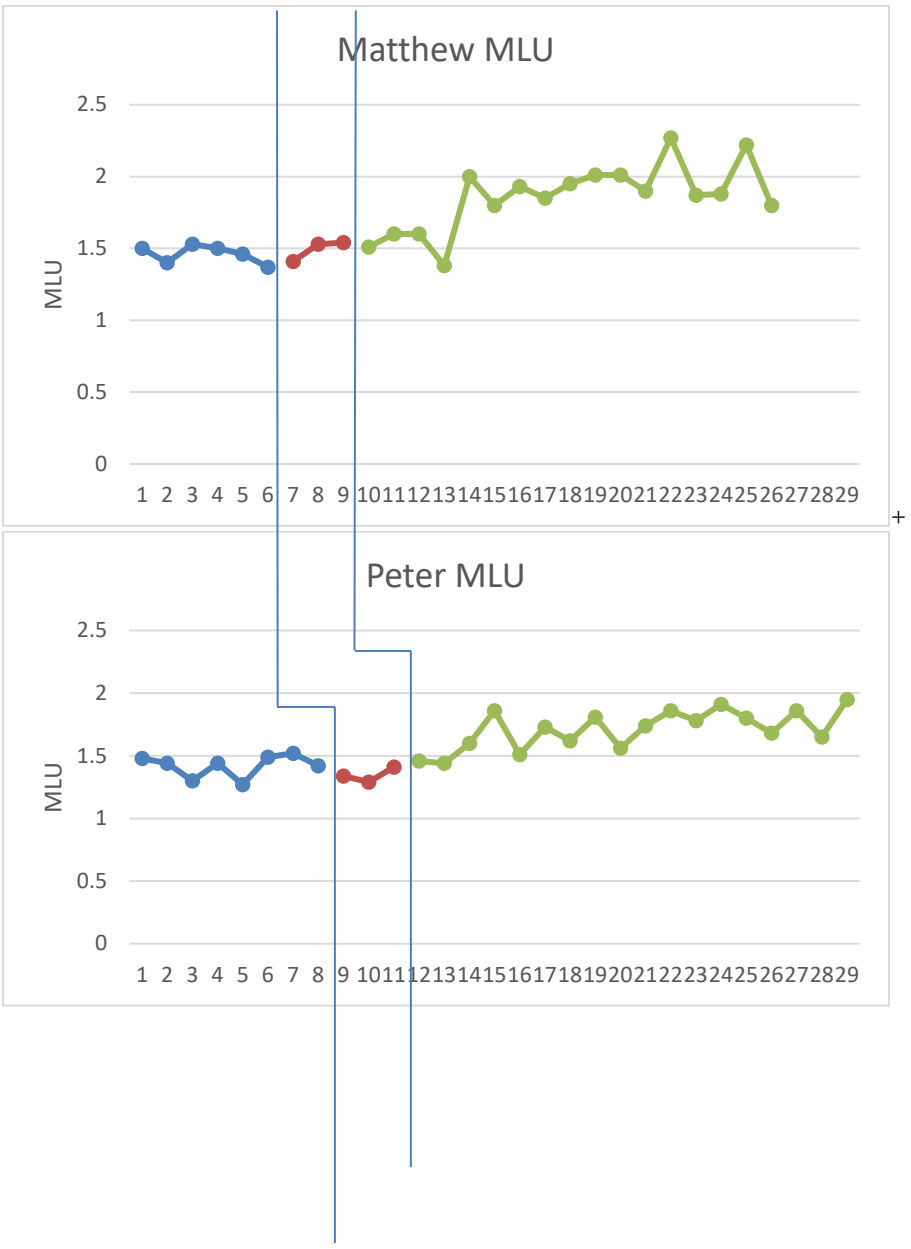
Immediacy of Effect

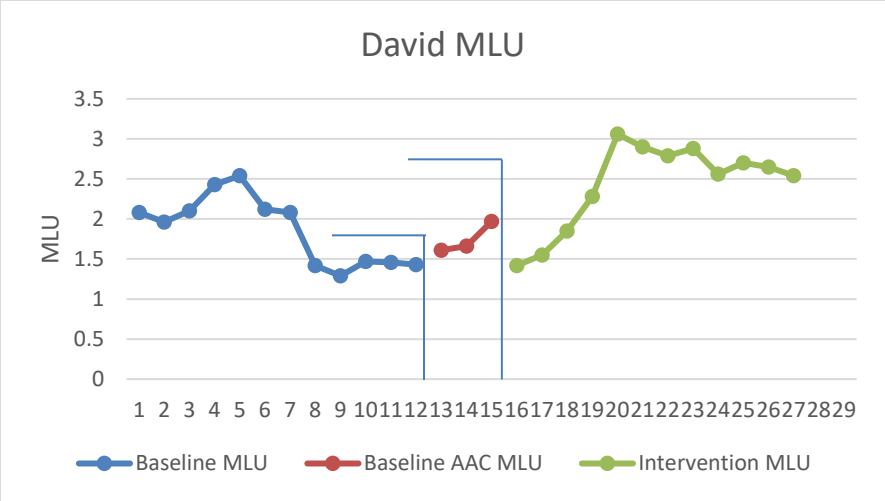
Immediacy of effect is another measurement discussed by Kratochwill et. al. (2013), which refers to the change in level after the start of the intervention. Kratochwill et. al. (2013) recommend comparing the last three data points from the baseline and the first three from the intervention, although they noted that using three data points is an arbitrary number and that other numbers of data points can be used to judge the immediacy of effect. Using the change in level after the start of the interventions, the three participants did not demonstrate an immediacy of effect within the first three data points as compared to the last three data points from the baseline. Still, if one looks at the first five data points, then one does see that there is an effect for all three participants.

Overlap

Overlap of data was another area used to examine multiple baseline design. Overlap dealt with how similar the data points were between the baseline, baseline with AAC, and intervention phases (Kratochwill et. al., 2013). For two of the three participants, there is little overlap between the baseline and intervention phases. However, because of the decreasing MLU in the baseline for the third participant, there are overlapping data between baseline and intervention phases.

Figure 5: MLU all three participants





Effect Size Calculations

Two different measures were used to reflect the magnitude of effects for each of the three participants. These were the standard mean difference (SMD) and the Tau-U. SMD was calculated between the baseline, baseline AAC, and intervention conditions (Hedges, Pustejovsky, & Shadish, 2012). SMD was chosen for the following reasons. This statistic places the single case design study into a similar metric as other studies and provides a way to compare the current study with other similar studies (Rakap, 2015). It also compares the means of the participant's MLUs across the three conditions. A simple calculation is used to determine the effectiveness of an intervention. Also, SMD can clearly communicate the effect size for multiple baseline designs such as the one used in this study (Gage &Lewis, 2013; Olive & Franco, 2007; Rakap, 2015).

Although SMD is commonly used in a variety of single case designs (SCD), including multiple baseline designs, some authors assert that the standard SMD may overestimate (Durlak, 2009) or underestimate an effect size (Hedges, Pustejovsky, & Shadish, 2012). However, other researchers have noted that the use of SMD may provide more information when examining

multi-baseline design, as it allows for a more concrete measurement of effect size using Cohen's d, a common measurement in the social sciences (Gage &Lewis, 2013; Olive & Franco, 2007; Rakap, 2015). In addition, Hedges, Pustejovsky, & Shadish (2012), acknowledged that a common metric such as Cohen's d is useful for comparing results across studies. However, Durlak (2009) noted that Cohen's d can overestimate effect sizes. Furthermore, even though alternative means for interpreting effect sizes are encountered in the literature, these methods also contain assumptions which potentially impact interpretation of effect size. In addition, many studies continue to use Cohen's d to estimate effect sizes (Gage &Lewis, 2013; Olive & Franco, 2007; Rakap, 2015).

Tau-U was also used to calculate the effect size. This was done in order to mitigate any over or underestimation using the SMD. Tau-U is a non-parametric statistic used in single subject research design (Parker, Vannest, Davis, J.& Sauber, 2011; Rakap 2015). Whereas SMD compares means between conditions, Tau-U measures the overlap between the phases. Tau-U has been used in a variety of Single Case Designs (SCDs) and has been used effectively in multiple baseline studies such as the current study (Rakap, 2015).

Standard Mean Difference Calculations

SMD compares the differences between the baseline and intervention means and the baseline with AAC and intervention phase. SMD was calculated using the following formulas. The mean of each phase is represented by μ and SD represents the standard deviation at the baseline. For comparison of baseline and intervention the following formula was used.

$$\mu^{Intervention} - \mu^{baseline} / sd^{baseline} = SMD$$

According to Cohen, who developed the SMD with group data, 0.2 is a small effect size, 0.5 is a medium effect size, and 0.8 is a large effect size. Based on the SMD calculation, there is

a large effect size for change in MLU over the course of the study. There is also a large effect size for the difference between the MLU during the baseline and intervention stages and the baseline with AAC and intervention stages. See table 5 and 6 for more information.

Table 5: Standard Mean Deviations Between Baseline and Intervention

Participant	SD Baseline	Mean Baseline	Mean Intervention	SMD
Matthew	0.06	1.46	1.85	6.32
Peter	0.09	1.42	1.71	3.26
David	0.4	1.87	2.43	1.32

Table 6: Standard Mean Deviations Between Baseline AAC and Intervention

Participant	SD Baseline	Mean Baseline AAC	Mean Intervention	SMD
Matthew	0.06	1.49	1.85	5.79
Peter	0.09	1.35	1.71	4.08
David	0.4	1.75	2.43	1.59

Tau-U Calculations

Tau-U was calculated for each student comparing the following phases to each other: baseline and intervention, the baseline and baseline with AAC, baseline with AAC and intervention. Furthermore, this information was then combined to give an overall average Tau-U to examine the effectiveness of the intervention across participants since the overall design of the study is comparing the effect of the intervention across the participants. Scores were determined by comparing scores from the baseline, baseline with AAC, and intervention phases. An online calculator was used to compute Tau-U (Vannest, K., Parker, R., Gonen, O., & T. Adiguzel, 2016). Also, each baseline was evaluated to determine if there were any internal trends. The results are in tables 7, 8, 9, 10 and 11. The formula for Tau-U is as follows:

$$\text{Tau-U}=S_p-S_a/mn+m(m-1)/2$$

S_p is the comparison between phase, while S_a is the baseline. M is the baseline phase observations and n is the intervention phase observations (Parker et al., 2011). The Tau-U scores are 0 to 1. Tau-U greater than or equal to .93is considered very effective, Tau-U between .66 and .93isconsidered effective, and scores below .66areconsidered questionable. For Matthew and Peter, the Tau-U for the interventions was considered effective to very effective. However, for David the effect of the intervention was questionable. Their Tau-U scores are found in tables seven to nine. Overall, the intervention was effective when looking at all three participants based on the cumulative Tau-U score in table 10.

Table 7: Tau-U Scores for Matthew

Participant	Phases	Tau-U	Z score	P value	90%Confidence interval	Effect Size
Matthew	Baseline 1 vs Baseline 1	-.40	-1.13	.26	-.98 to .18	No trend
	Baseline 2 vs Baseline 2	1	1.57	.12	-.05 to 1.00	No trend
	Baseline 1 vs Baseline 2	.50	1.16	.25	-.21 to 1.00	No trend
	Baseline 1 vs Intervention	.88	3.15	.002	.42 to 1.00	Effective
	Baseline 2 vs Intervention	.80	2.17	.03	.19 to 1.00	Effective

*Baseline 1 is the first baseline without AAC and Baseline 2 is the second baseline where the AAC system is present but not modeled.

Table 8: Tau-U Scores for Peter

Participant	Phases	Tau-U	Z score	P score	90%Confidence interval	Effect Size
Peter	Baseline 1 vs Baseline 1	.04	.12	.90	-.44 to .51	No trend
	Baseline 2 vs Baseline 2	.33	.52	.60	-.72 to 1.00	No trend
	Baseline 1 vs Baseline 2	-.58	-1.43	.15	-1 to .09	No trend
	Baseline 1 vs Intervention	.88	3.56	.0004	.478 to 1.00	Effective
	Baseline 2 vs Intervention	1	2.71	.007	.394 to 1.00	Very Effective

Table 9: Tau-U Scores for David

Participant	Phases	Tau-U	Z score	P score	90%Confidence interval	Effect Size
David	Baseline 1 vs Baseline 1	.41	1.85	.06	-.05 to 1	No trend
	Baseline 2 vs Baseline 2	1	1.57	.12	-.77 to -.04	No trend
	Baseline 1 vs Baseline 2	.11	-.29	.77	-.74 to .52	No trend
	Baseline 1 vs Intervention	.88	2.60	0.0007	.23-1.00	effective
	Baseline 2 vs Intervention	.53	1.59	.71	-.22-1.00	Questionable effectiveness

Table 10: Tau-U Scores for all three participants

All Participants	Phases	Tau-U	Z score	P score	90%Confidence interval	Effect Size
	Combined Baseline to Intervention	.79	5.35	.0001	.55 to 1.00	Effective

Table 11: Average MLU for Children during Various Stages of Study

	Matthew	Peter	David
Initial Language Sample MLU	1.39	1.95	1.39
Number of Utterances	99	77	66
Baseline MLU	1.46	1.42	1.87
Average Utterances	93	56	46
Baseline with AAC MLU	1.49	1.35	1.75
Average Utterances	94	70	77
Intervention MLU	1.85	1.71	2.43
Average Utterances	120	96	114
Final Language Sample	2.16	2.17	2.46
Number of Utterances	121	116	99

Changes in Average MLU Shared Book Reading Sessions

As noted in table 11, there were changes in MLU for all three students. All three students had an increase in MLU when comparing initial language samples and baseline language samples. Furthermore, there is very little difference in MLU between the baseline and baseline with AAC sessions for all three boys. There is an increase in MLU between the baseline with AAC and intervention phases.

Changes in Average MLU Play Sessions

After the shared book reading experiences, the researcher and the participant took part in short play sessions. As noted in table 12, the average MLUs for two of the three participants increased after the start of the intervention phase during the play sessions. The third participant's

average MLU decreased slightly between each phase during the play sessions. For all three participants, the average MLUs remained steady between the two baselines during the play sessions. Matthew's and David's average MLU increased after the start of intervention while in the play sessions and there was a decrease in MLU for Peter as well.

Table 12: MLU during Play Sessions

	Matthew	Peter	David
Initial Language Sample MLU	1.39	1.95	1.39
Number of Utterances	99	77	66
Baseline MLU	1.39	2.03	1.59
Average Utterances	98	44	33
Baseline with AAC MLU	1.41	1.96	1.66
Average Utterances	70	33	30
Intervention MLU	1.99	1.89	2.46
Average Utterances	100	44	55
Final Language Sample	2.16	2.17	2.47
Number of Utterances	121	116	91

Three Longest Sentences/ Utterances During Shared Book Reading

The three longest utterances for each participant in each condition were measured in order to determine if the children's longest utterances changed, in addition to the mean length of utterances. The longest sentences of each child in the various stages can be viewed as an indication of what the child is capable of in terms of sentence lengths.

Examples of each of the participants' utterance lengths are provided in Table 13. As can be seen, each participant was able to formulate some longer utterances even during the initial language sample. Children's sentences and utterances during the baseline language samples were anywhere between 3-4 morphemes in length. The average MLUs for the three longest sentences during the baseline language sample were: 3.66 for Matthew, 4.0 for Peter, and 3.66 for David. During the baseline sessions, their longest utterances or sentences were between 3-5 morphemes in length. The average MLUs for the three longest sentences were: 3.66 for Matthew, 3.0 for Peter, 4.33 for David. While in the baseline AAC sessions their utterances/sentences were between 2-4 morphemes in length. The average MLUs for the three longest sentences were: 3.66 for Matthew, 2.33 for Peter, and 3.66 for David. During intervention, this range was between 4-8 morphemes. The average MLUs for the three longest sentences were: 5.33 for Matthew, 4.67 for Peter, and 7.0 for David. After the final language sample, their longest sentences/utterances were between 4-8 morphemes in length. The average MLUs for the three longest sentences were: 4.67 for Matthew, 5.0 for Peter, and 6.0 for David. After the start of intervention on average the participants' longest sentences/utterances increased.

Table 13: Examples of Three Longest Utterances During Shared Book Reading

			3 Longest Sentences			
Condition	**Matthew**	**Average MLU**	**Peter**	**Average MLU**	**David**	**Average MLU**
Baseline Language Sample	I see up in here.	3.66	Hello how are you?	4.0	Its cops.	3.66
	I want block.		I want daddy up.		Where's the game?	
	I blow down.		I want mommy up.		There you go.	
Baseline Sessions	Hey here bus come.	3.66	Eat I like.	3.0	Pets need to play.	4.3
	Hey where me go.		Like cookies.		Spiderman climb walls.	
	I read book.		I want sucker.		Raise your hand.	
Baseline with AAC	I like that one.	3.66	Delicious desserts.	2.33	Look a triceratops.	3.66
	I see you big		More time.		See me battle.	
	I not baby.		Running.		School bus is away.	
Intervention	I like chips here.	5.33	Don't forget the cereal.	4.67	What did you do leaves?	7.0
	Now stopped switched off		I eat one bite.		Sea dinosaurs lived in the sea.	
	You got keys inside.		I don't want to do that.		Dinosaurs ate a lot of meat	
Final Language Sample	Hey see that baby here.	4.67	This is what I want on my lap.	5.0	Hey look this is a brachiosaurus.	6.0
	Here want baby play too.		I want hamburgers		Boy is he ready to fight	
	I don't brush teeth.		Would have been here.		Are you sure this is done?	

Three Longest Sentences/Utterances Shared Book Reading

Children's sentences and utterances during the baseline language samples were anywhere between 3-5 morphemes in length. The average MLUs for the three longest sentences were during the baseline language sample were: 3.66 for Matthew, 4.0 for Peter, and 3.66 for David. During the baseline sessions, their longest utterances or sentences were between 2-4 morphemes in length. The average MLUs for the three longest sentences were: 2.67 for Matthew, 2.0 for Peter, 2.67 for David. While in the baseline AAC sessions their utterances/sentences were between 2-4 morphemes in length. The average MLUs for the three longest sentences were: 2.67 for Matthew, 2.0 for Peter, and 3.00 for David. During intervention, this range was between 3-6 morphemes. The average MLUs for the three longest sentences were: 5.33 for Matthew, 4.67 for Peter, and 5.33 for David. After the final language sample, their longest sentences/utterances were between 4-7 morphemes in length. The average MLUs for the three longest sentences were: 4.67 for Matthew, 5.0 for Peter, and 6.0 for David. After the start of intervention on average the participants' longest sentences/utterances increased. Table 14 provides more information regarding baseline and intervention during play sessions.

Table 14: Examples of Three Longest Utterances During Play Sessions

	3 Longest Utterances					
Condition	**Matthew**	**Average MLU**	**Peter**	**Average MLU**	**David**	**Average MLU**
Baseline Language Sample	I see up in here.	3.66	Hello, how are you?	4.0	Its cops.	3.66
	I want block.		I want daddy up.		Where's the game?	
	I blow down.		I want mommy up.		There you go.	
Baseline Sessions	Hey I like that.	2.67	Clean up.	2.0	Not now.	2.67
	Bye-bye outside.		No more episode.		A chicken bawk.	
	Go night-night.		Running.		That not good.	
Baseline with AAC	Here the farm play.	2.67	Go night-night.	2.0	Blue a toy.	3.0
	This sheep sleeping.		Mommy call.		Head tail foot.	
	Hey a cat.		Red sheep.		Who's see?	
Intervention	Over there I have both sheep.	5.33	I want green.	3.0	I want jump right here.	5.33
	Here door locked stuck.		I want hamburger.		What did you do in here?	
	Hey see that baby here.		You were there.		It's a tyrannosaurus rex.	
Final Language Sample	Hey see that baby here.	4.67	This is what I want on my lap.	5.0	Hey look this is a brachiosaurus.	6.0
	Here want baby play too.		I want hamburgers		Boy is he ready to fight.	
	I don't brush teeth.		Would have been here.		Are you sure this is done?	

Types of Verbalizations During Shared Book Reading

The participants' responses were coded as IV (Independent Verbal), M (Verbal Modeled), P (Prompted) and SGD (Speech Generating Device). The types of the participants' responses varied during each phase of the study. Two of the children were highly echolalic throughout the study, resulting in many Modeled utterances.

As shown in Table 15, Matthew's data showed very little difference between the baseline and baseline with AAC phases for independent verbal responses. For Peter and David, however, there was a slight drop in independent verbal responses between the two baseline phases (Peter: 41% to 35%, David: 50% to 39%). Verbal modeled responses were almost the same for Peter. However, for David verbal modeled responses dropped but only slightly (42% to 16%). Verbal modeled responses increased for Matthew (0.02% to 4%). Prompted responses for Matthew and Peter were almost the same between the baseline and baseline with AAC phases. David's prompted responses decreased during the baseline to baseline with AAC phases (8% to 2%). Both Peter and David used the AAC system during the baseline with AAC shared reading sessions.

When looking at the types of utterances between the baseline with AAC stage and the intervention stage, again Matthew did not have a change in his independent verbal responses. Both Peter's and David's independent responses were more frequent during the intervention stage than in the baseline stage. Modeled responses for Matthew remained the same, while Peter's modeled responses decreased (57% to 55%), and David's modeled responses increased. Matthew's prompted responses decreased (9% to 4%) between the baseline with AAC phases and the intervention phases. Peter's and David's prompted responses increased. Matthew's and

Peter's responses with the SGD increased while David's use of the SGD decreased (see Table 15 for more information).

Table 15: Quality of Participant's Responses During Shared Reading Experience

	Matthew	Peter	David
Baseline Language Sample			
Independent Verbal	84% (76/90)	65% (40/62)	64% (61/96)
Verbal Modeled	5% (5/90)	19% (12/62)	27% (26/96)
Prompted	10% (9/90)	16% (10/62)	9% (9/96)
Baseline Sessions			
Independent Verbal	90% (480/534)	41% (192/465)	50% (238/474)
Verbal Modeled	.02% (8/534)	57% (264/465)	42% (197/474)
Prompted	10%(56/534)	2% (7/465)	8% (39/474)
Baseline with AAC			
Independent Verbal	86% (184/213)	35% (68/192)	39% (99/255)
Verbal Modeled	4% (9/213)	55% (105/192)	16% (40/255)
Prompted	9% (20/213)	1% (1/192)	2% (7/255)
SGD	0% (20/213)	9% (18/192)	43% (109/255)
Intervention			
Independent Verbal	84% (1644/1957)	49% (797/1625)	58% (794/1360)
Verbal Modeled	4% (78/1957)	41% (659/1625)	21% (286/1360)
Prompted	4% (80/1957)	1% (23/1625)	1% (13/1360)
SGD	8% (155/1957)	9% (146/1625)	19% (263/1360)
Final Language Sample			
Independent Verbal	85% (96/114)	63% (78/123)	95% (94/99)
Verbal Modeled	0% (0/114)	22% (27/123)	2% (2/99)
Prompted	15% (18/114)	11% (13/123)	3% (3/99)
SGD	0% (0/114)	4% (5/123)	0% (0/99)

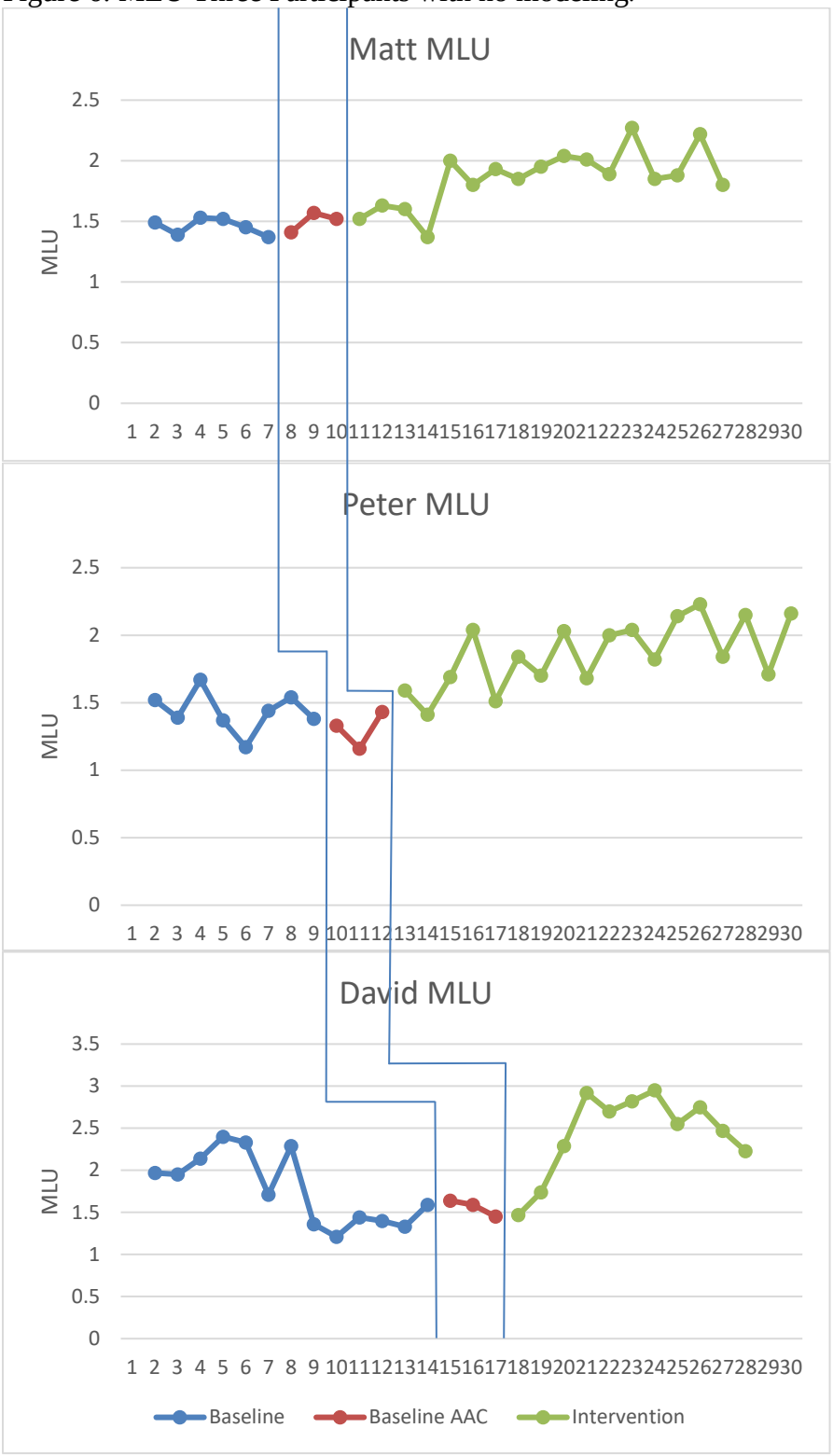
MLU Without Modeled Responses

Two of the children, Peter and David, had echolalia. This is important because this variable may be a possible confound in determining if AAC increased their oral language or if they had simply become better at imitating the researcher. In order to account for the contribution of modeled utterances, MLU was re-calculated without the modeled responses.

Matthew's MLU remained unchanged. However, Peter had more variability, and there was a rising baseline in the baseline with AAC phase. For David, the rising baseline noted in the baseline with AAC phase was no longer present. In addition, there was a rising baseline for the last data point in the baseline stage. Overall, Peter and David's baselines were unstable in both the baseline and baseline with AAC phase, once Modeled utterances were removed.

Results from the re-analysis should be viewed with caution because the number of utterances used to calculate the MLUs without the modeled responses were low. In one case only three utterances were used to calculate the MLU. In general, many of the language samples were reduced to fewer than 50 utterances. In order to get a representative language sample, at least 50 to 100 utterances are recommended (Guo & Eisenberg, 2015; Miller &Chapman, 2000; Tomasello & Stahl, 2004). Figure 6 shows the graphs without the modeled data included for all three participants.

Figure 6: MLU Three Participants with no modeling.



Type of Participant's Responses During Play Sessions

When comparing the baseline and baseline with AAC phase Matthew's and Peter's independent verbal responses decreased during the play sessions (Matthew: 72% to 48%, Peter: 44% to 26%). David's independent verbal responses increased between the baseline and baseline with AAC phases (57% to 69%). Matthew's verbal modeled responses were almost the same in both the baseline and baseline with AAC phases. David's verbal modeled responses decreased between the baseline and baseline with AAC phases (24% to 7%). Peter's verbal modeled responses increased between the two baseline stages (19% to 34%) Prompted responses for Matthew and David increased between the baseline and baseline with AAC phases (Mathew: 23% to 46%, David: 18% to 24%). Prompted responses for Peter were about the same between the two phases.

When comparing the baseline with AAC sessions and intervention, during the play sessions, the percentage of utterances that were IV increased meaningfully for all three participants. Verbal modeled responses increased for David (7% to 13%), while Peter's modeled responses decreased (42% to 18%). Matthew's verbal modeled responses were about the same. For David and Matthew prompted responses decreased (David: 24% to 8%, Matthew: 46% to 23%) for Peter prompted responses increased (23% to 30%) when comparing the two phases. Peter used the AAC system more during intervention compared to the baseline with AAC condition, but only slightly. Matthew and David did not use the AAC system during play sessions during the intervention stage. See table 16 for more information.

Table 16: Type of Participant's Responses During Play Session

	Matthew	Peter	David
Baseline Language Sample			
Independent Verbal	84% (76/90)	65% (40/62)	64% (61/96)
Verbal Modeled	5% (5/90)	19% (12/62)	27% (26/96)
Prompted	10% (9/90)	16% (10/62)	9% (9/96)
Baseline Sessions			
Independent Verbal	72% (154/213)	44% (41/93)	57% (59/103)
Verbal Modeled	5% (10/213)	34% (20/93)	24% (25/103)
Prompted	23% (49/213)	22% (32/93)	18% (19/103)
Baseline with AAC			
Independent Verbal	48% (26/54)	26% (8/31)	69% (20/29)
Verbal Modeled	6% (3/54)	42% (13/31)	7% (2/29)
Prompted	46% (25/54)	23% (7/31)	24% (7/29)
SGD	0%(0/54)	9% (3/31)	0% (0/29)
Intervention			
Independent Verbal	72% (154/213)	43% (57/132)	79% (108/137)
Verbal Modeled	5% (10/213)	18% (24/132)	13% (18/137)
Prompted	23% (49/213)	30% (39/132)	8% (11/137)
SGD	0% (0/213)	9% (12/132)	0% (0/137)
Final Language Sample			
Independent Verbal	85% (96/114)	63% (78/123)	95% (94/99)
Verbal Modeled	0% (0/114)	22% (27/123)	2% (2/99)
Prompted	15% (18/114)	11% (13/123)	3% (3/99)
SGD	0% (0/114)	4% (5/123)	0% (0/99)

Chapter 4: Discussion

This study sought to examine the effects of AAC on the oral language of participants with limited language. In particular, the following research question was addressed:

> Does training children with expressive language disorders to use AAC increase the children's use of longer spoken utterances, as measured by mean length of utterances?

The following hypothesis was proposed: The use of the AAC system will increase the ability to combine two words or more words verbally, as measured by MLU in morphemes.

The answer to the research question is inconclusive based on results from this study. For two of the three children, MLUs that included Modeled responses increased after AAC was added to story book reading. The SMD indicated that there was a significant difference between the intervention and baseline phase. The Tau-U calculations showed that the intervention was effective to very effective when examining the data across the three participants.

The impact on the third student is unclear. The SMD indicated that there was a significant impact, while the Tau-U indicated a questionable effect, when comparing the second baseline to the intervention. However, the student did make gains which were apparent on the multiple baseline graph. The SMD indicates that there is a change in the mean scores when comparing the baseline, baseline with AAC and intervention phases. Furthermore, the Tau-U examines the data that is non-overlapping between the three phases. Tau-U seems to indicate that for the third student there is some overlap between the three phases which is why for the third student the effect is questionable.

This participant (David) did have a rising baseline during the last session of the baseline with AAC condition. This indicates that some of his increased verbalization may be attributed to

outside factors or perhaps even introduction of the AAC system. David was the most prolific user of the AAC system, especially when it was introduced. Still, his MLU decreased again at the start of the intervention sessions. This indicates overlap between the last data point and the intervention phase. This is reflected in the Tau-U results. When calculating the significance, however, there was a prominent difference between the three conditions.

During the play sessions, two of the three participants demonstrated an increase in MLU. One participant's (Peter) MLU across the play sessions was consistent across all three conditions. This participant's responses were highly echolalic during the play sessions, which is why his overall oral language production was steady during all three conditions.

The type of participants' utterances was also examined in relation to communication. As noted in the methods their responses were coded as independent verbal (IV), verbal modeled (M), or prompted (P). The types of responses used by the participants was consistent for all three. This indicates that the type of the participants' communication was not impacted by the use of the AAC systems.

Two of the three participants were echolalic. This is reflected in the increased use of the model-coded utterances for these two children. For example, one participant (Peter) would repeat all or part of what the researcher just stated. Peter's verbal modeled responses accounted for 41% to 57% of his responses in all stages of the study. However, David, who also demonstrated echolalia, used more verbal modeled responses and less independent verbal responses during the baseline and baseline with AAC conditions than during the intervention stage. During the intervention stage, his independent verbal responses increased markedly and his modeled responses decreased. Nevertheless, the participants did combine more morphemes as measured by MLU.

The MLU and the ability to combine words increased after the introduction of the AAC system in tandem with modeling of this system. During the intervention phase, the participants began to combine more words together and would use some of the words from the books in unique ways. For example, Peter indicated that he liked waffles and thought they were delicious by noting, during the shared book reading experience, that waffles were a delicious dessert. His book incorporated several references to a variety of desserts, and he used the phrase "delicious desserts" repeatedly during the shared book reading experience. His mother noted that he started referring to all the foods that he liked outside of therapy as "delicious desserts."

At the start of the baseline sessions, Matthew used limited combinations of words, pointing, and sign language to augment his oral language. Towards the end of the intervention sessions, he verbalized quite a bit and he significantly increased his MLU. This trend was true for all three participants. Each participant produced significantly lower MLUs at the start of the baseline sessions than at the end of the intervention sessions. Matthew's mother noted that before the study she found it difficult to get Matthew to speak in utterances longer than one or two words. However, after the intervention he was able to make longer and more coherent utterances.

David used the AAC system to self-cue. Many times, he added and deleted words and then stated aloud what the AAC system just stated. He composed novel statements on the AAC system and then verbally stated them after listening to the AAC system. This synthesis demonstrated that David used the AAC system to scaffold his oral language when he repeated what the system stated.

In summary, the use of the AAC system seemed to help the three participants put more words together as measured by their increased MLUs. However, considering the level of

echolalia by the two participants with autism, it is difficult to discern if the use of AAC increased their oral language or if they had simply become better at imitating the researcher.

Shared Book Reading and Language Development

Another explanation for the increase in MLU may be attributed to the shared storybook reading context in which the baseline, baseline with AAC, and intervention conditions occurred. The use of shared book reading has been demonstrated to have a positive impact on language development in participants (Hargrave & Sénéchal, 2000). For instance, Hargrave and Sénéchal examined shared book reading in preschool settings. This study specifically examined the role of dialogic reading and shared book reading. Both types of book reading were considered effective; however, dialogic reading was more effective than simple shared book reading. Although both groups displayed improvement in receptive and expressive language, the dialogic group demonstrated significant gains in these areas. However, the design of the study did not include controls, so although it appeared that dialogic reading was more effective, narrative or conversation might have been just as effective. In addition, it is unknown if the participants had worked with an SLP in a shared book reading context prior to the study.

The dialogic method used in this study was similar to the methods used in the current study. Hargrave and Sénéchal (2000) used the following procedures: questions, followed by correct answers with another question, repetition of the participant's response, help for the participant as needed, and praise and encouragement, along with inclusion of the participant's interests. The current study included some of these procedures. Specifically, the wh- questions, repetition, and praise were present. The books were based on the participant's interests. Therefore, it is possible that the shared book reading impacted the participants' language

development, as suggested by a study conducted by Sénéchal, Pagan, Lever and Ouellette (2008). Still, gains in MLU were not apparent until after the introduction of the AAC systems.

In the study by Sénéchal et. al (2008), they reviewed the impact of shared book reading and parent literacy on 106 participants. They used a combination of parent questionnaires and language assessments to gauge the contribution of shared book reading and parental literacy on the participants' receptive and expressive language, including morphology, syntax, and narrative ability. The study found that shared book reading did make significant contributions to a participant's expressive language and morphological knowledge, when controlling for factors such as parental literacy and participants' cognitive development. Again, this would seem to indicate that the shared book reading may have contributed to the participant's increase in MLU, since this study noted that shared book reading made a significant contribution to a participant's expressive language and morphological knowledge. Yet, as noted earlier, there was no improvement in MLU until the introduction of AAC. However, the improvement in the current study could also have been impacted by the parents' literacy levels, or participants' cognitive development, but these factors were not taken under consideration.

A third study by Hindman, Skibb, & Foster (2014) examined parental talk and its role in participant literacy. This study examined the pre-existing data that included 800 participants. They looked at code-related talk and meaning-related talk in the context of shared book reading. Code-related talk described the parents talk about graphemes and phonemes related to the book being read. Meaning-related talk refers to parental talk about the meaning of the book being shared. After analyzing the data, the researchers noted that the type of talk impacted two different areas. Code-related talk predicted participant literacy, while meaning-related talk was a predictor of participant language. During the current study, there were instances of both types of

talk. However, this data was not quantified. It is possible that the type of talk impacted the participants' MLU, but this question would need to be further explored.

In summary, studies have been conducted which demonstrated that shared book reading does have an impact on language development, even when controlling for factors such participant cognitive factors and parental literacy (Hargrave &Sénéchal, 2000; Hindman et al., 2014). It is possible, considering the extant literature, that shared book reading impacted the oral language of the participants in the study. Further study on the impact of shared book reading for children who use AAC would be beneficial.

Autism and Language development

Children diagnosed with autism demonstrate atypical language development. They may demonstrate some splinter skills that exceed peers without the diagnosis of autism. Yet at the same time they have significant delays in other areas (Park, Yelland, Taffe, & Gray, 2012; Tek, Mesite, Fein and Naigles, 2013).

One study by Tek et al. (2013) noted that children diagnosed with autism who were highly verbal had language development patterns similar to children without a diagnosis of autism. Three groups were compared including two groups of children diagnosed with autism. One group was highly verbal, while the other was classified as a low verbal group. Their language development, including MLU was compared to the third group comprised ofchildren who were not diagnosed with autism. The children classified as highly verbal demonstrated MLUs similar to their peers classified as typically developing. The two participants in this study diagnosed with autism were quite verbal, even though they exhibited delayed receptive and expressive language. Perhaps if they had been less verbal, the overall outcome may have been

different. Yet it is difficult to determine because another less verbal child with autism would have been excluded from the study based on the criteria stated in the methodology.

Language Delays and MLU

One of the participants was classified under the category of young child with developmental delays (YCDD). This participant's receptive language scores were above average, even though his expressive language scores were below average. Considering the scores on the PPVT, this participant might be classified as a late talker, as his receptive language was similar to peers his age (Rescorla, & Turner, 2015).

Children classified as late talkers tend to have similar expressive language skills after entering elementary school. Receptive language scores develop before expressive, so it is not surprising that the participant's MLU increased. Yet this increase was not noted until after the start of the intervention phase. Also, as noted he exhibited the capability to form some longer utterances, yet as reflected by his MLU he rarely did so until after the initiation of the intervention phase.

AAC and Oral Language

The extant literature contains many articles focused on the use of AAC systems for participants with complex communication needs with little or limited oral language (Adamson, Bakeman, Deckner, & Romski, 2009; Checkley et al., 2012; Mathisen et al., 2009). The participants in these studies used 20 spoken words or less. The current study's findings seem to concur with and extend this extant literature base (Adamson et al., 2009; Checkley et al., 2012; Mathisen, 2009). In addition, the participants in the current study spoke at least 20 words before starting the study.

In general, the participants in the studies reviewed demonstrated increased oral language after the introduction of AAC systems (Checkley et al., 2012; Mathisen, 2009). Additionally, if no increase in oral language occurred, then AAC was not effective in those cases (Adamson et al., 2009). However, in all cases, improvements in overall communication, language and oral language development occurred (Adamson et al., 2009; Checkley et al., 2012; Mathisen, 2009).

In other studies, AAC impacted oral language (Adamson et al., 2009; Checkley et al., 2012; Mathisen et al., 2009), even when oral language was not a targeted goal of the study (Adamson et al., 2009). For example, Adamson et al. (2009) reported an increase in verbal output for participants who spoke less than 10 words prior to onset of intervention. The sample size for this study was larger than the current study with a group of 57 toddlers. Although the main purpose of the study was to examine joint attention, it did report that 25 of the 57 participants increased their verbal output after the initiation of intervention.

Other studies indicated that after the introduction of AAC, participants demonstrated an increase in MLU (Checkley et al., 2012; Mathisen, 2009). For instance, the study by Checkley et al. (2012) described the effect of AAC on the MLU of participants with ASD during literacy sessions in the classroom led by an SLP. All three participants in their study demonstrated a significant increase in MLU after a baseline stage without SGD. This current study concurs with those findings. However, as a caveat, the studies (Adamson et al., 2009; Checkley et al., 2012; Mathisen, 2009) were non-experimental and lacked controls, so even though gains in oral language were reported, it is difficult to note whether this was due to the use of the AAC system or some other factor. In addition, without controls, it is difficult to determine whether some other method may have been just as effective as the ones used in the studies. Only one study (Romski

et al., 2010) had a control group and this study noted only that the children increased their use of target vocabulary when provided with an AAC system.

In summary, the current study's findings seem to concur with the extant literature (Adamson et al., 2009; Checkley et al., 2012; Mathisen, 2009). The participants in the current study increased their MLU after the introduction of AAC. In particular, this increase in MLU came after the introduction of AAC while the researcher was modeling the AAC system. The system may have aided in the increase in verbal MLU because it provided both auditory and visual input for the student, as well as multiple demonstrations. However, it is difficult to know whether the participants truly increased their oral language or simply became better at imitating the researcher. Nonetheless, the use of the AAC system overall did not have a negative impact on oral language for the three participants in this study.

Alternative Causes for Findings

Other factors may explain the increased MLU demonstrated by the three participants in the current study. The first factor may be that the participants demonstrated simple maturation over the course of the study. That is, the participants may have simply increased their MLU over time without the use of AAC systems. As one participant did demonstrate an increase in their MLU during the baseline AAC phase, this is a probable alternative cause. However, this increase did take place after the introduction of AAC, so considering the extant research base (Adamson et al., 2009; Checkley et al., 2012; Mathisen, 2009) it may be that the introduction of the AAC system influenced his oral language. This participant, David, showed an increased interest in the AAC system and used the system during the baseline with AAC phase. In contrast, the other two participants did not begin to use the AAC system until after the start of intervention Furthermore, it is difficult to note if the AAC system alone or the modeling of the AAC system impacted the

MLU more. In general, gains in MLU increased after the start of the intervention stage which included modeling of the AAC system. This modeling allowed for more auditory and visual repetitions of the information presented and may be another explanation for the increase in MLU.

Why AAC May Have Impacted MLU

The participants' comprehension of the book may have been aided by the AAC system as demonstrated by their verbal output. The participants were able to hear the words and see the words on the AAC system. This provided reinforcement for the language being presented during the shared book reading experience.

Furthermore, the researcher provided a verbal model while using the AAC system simultaneously. This modeling impacted the participants' MLU, as they could hear the use of the words as they were being read. The participants were able not only to visualize what was stated but also to demonstrate increased expression of language. The information was read by the researcher, but also repeated by the AAC system. Furthermore, the participants were able to use the AAC system to listen to the message presented. This resulted in multiple exposures to the same information for each page. Therefore, this ability provided opportunities for the participants to comment on the content of the book being read.

The books used during the shared book reading experience were based on the child's interests in hopes that they were more likely to engage in the process compared to a generic text that they had no incentive to pay attention to. This use encouraged the child to pay closer attention to the stories and provided them with words they could learn and use on preferred topics. Consequently, they used these words to discuss some of their favorite topics during the

play sessions. Likewise, the participants were more engaged in the sessions resulting in increased opportunities for communication.

Clinical Relevance of Findings

As described in this study, participants with limited oral language benefited from the use of AAC in the therapeutic setting. The gains in MLU were modest, but gains were made with each participant. It would be interesting if more gains could be made with access to AAC systems during the entire day rather than only in the isolated sessions. Previous studies demonstrated that participants made gains in MLU with the use of AAC systems (Adamson et al., 2009; Bellon-Harn&Harn, 2008; Binger & Light, 2008; Checkley et al., 2012; Mathisen, 2009; Millar & Schlosser & Light; Romski&Sevcik, 2005).

Despite the school district opposition to the use of AAC for the participants, this short study showed they were able to make verbal gains and sustain attention. They all had 84 symbols per page. Further, they independently navigated the page to find preferred words that related to the book being read. In addition, the participants learned to put together two symbols and would imitate the symbols put together. The participants added words, deleted words, and imitated the symbols using AAC.

AAC systems such as the one used in this study are accessible. The system used is an application that can be purchased for the iPad. In fact, there are a variety of AAC systems that can be obtained on tablets, computers, or even as dedicated SGDs. Although initial training can be time intensive, with repeated use the therapist and the participant can learn to use an appropriate AAC system.

The methods used in this study included modeling the use of the AAC system. Modeling may be a beneficial strategy because, as the therapist models the use of the system, the

participant has multiple opportunities to enrich their language skills. That is because the AAC system provides a concrete model of language in action and in a context that is relevant to the participant. Furthermore, it gives a participant with language delays a chance to respond either with or without the AAC system, thus scaffolding the participant's language development.

One participant in this study (David), used the AAC system to formulate novel utterances, and then speak those utterances verbally. This impacted his MLU by increasing the length of his utterances. It may also have impacted his comprehension, but this is unclear, since the primary measure was MLU which examined verbal expression. Still, a therapist could potentially use an AAC system to facilitate language development in multiple areas, such as comprehension. This, is turn, could aid in increasing verbal expression (Bellon-Harn &Harn, 2008; Binger & Light, 2007; Checkley et al., 2012; Mathisen, 2009; Romski & Sevcik, 1996).

Binger and Light (2007) noted that the following benefits were realized after the introduction of AAC: decreased frustration, better language and communication skills (including increased expressive language skills) an improvement in the impression of the participant's communicative competence, and increased oral language. All of these skills would be beneficial for participants with complex communication needs.

Limitations of Current Study

The current study included a limitation that is common in the field of AAC. The sample size for this study is extremely small, so it is difficult to generalize the findings. For the participants in this study, the use of AAC seemed associated with increased modeled language. Other studies have reached similar conclusions, but again these same studies have small sample sizes as well (Adamson et al., 2009; Checkley et al., 2012; Mathisen, 2009; Romski et al., 2010).

Parental education, parental literacy, parent-child shared reading experiences, or other factors related to the parents may have impacted the participants' MLU. This study did not examine these factors. Parents were not asked about their education level or literacy skills. Nor was the amount of time, outside the sessions, that they spent reading with their child noted. Perhaps parents read more or less to the participants, as the main focus of the researcher's sessions across all conditions was shared book reading. These factors have been shown in some studies to impact a participant's language skills (Hindman et al., 2014; Sénéchal, Pagan, Lever & Ouellette, 2008). Perhaps future studies could consider these factors in the study design in order to rule out any impact contributed by shared book reading on the participant's oral language.

Echolalia may also have been a factor for increased MLU in two of the three participants. David and Peter both utilized a lot of oral language that would be classified as echolalia. At times, they repeated what the researcher stated either in whole or part. These repetitions were categorized under the verbal modeled code. This is especially important to note as a limitation since all oral language including speech that was modeled or prompted were included in the MLU calculations. Thus, an increase in MLU may be attributed to increased imitation rather than increased oral language.

When the modeled utterances were removed from the MLU calculations, the baseline and baseline AAC conditions of Peter and David were no longer consistent. However, Matthew's graph was virtually unchanged when modeled responses were removed. Conversely, Matthew did not present with echolalia. Furthermore, when the modeled responses were removed the number of utterances were reduced to less than 50 utterances (Guo & Eisenberg, 2015; Millar & Chapman, 2000; Tomasello& Stahl, 2004). This means that the calculated MLU may not have been representative.

All three participants were kept in the baseline with AAC stage for three sessions. It would have been better to have kept David in the baseline with AAC stage longer in order to establish a more consistent baseline. This participant in particular demonstrated a drop in baseline during the baseline phase. This was in part due to lack of consistency with his sessions due to illness and scheduling conflicts. This rise in baseline is concerning because it is then difficult to note whether the introduction of AAC impacted his MLU or if the modeling of AAC impacted his MLU.

Lastly, the three participants had different receptive language skills at the start of the study. Matthew had receptive language skills similar to his peers, whereas David and Peter had delayed receptive language skills. Thus Matthew was quite dissimilar from Davis and Peter. Differences between participants can impact the overall results in a multiple baseline across participants design (Kratochwill et al., 2013)

Further Research

Continuing research in this area would be useful. Many of the current research studies focused on the use of AAC as an alternative to oral language (Binger & Light, 2007; Checkley et al., 2012; Mathisen, 2009; Romski & Sevcik, 1996). Perhaps the use of AAC to augment existing oral language can be further explored, especially for those populations that have apraxia of speech, dysarthria, aphasia, or decreased intelligibility. These populations may also have some oral language, but due to developmental or acquired disabilities still have difficulty communicating.

AAC can be integrated throughout the participant's day. These systems can be used to aid instruction in core curriculum material. AAC can be used to model the information and can also be used to aid the participant in understanding core curriculum material. Again, AAC can be

used to augment the participants' existing oral language, and can be used as a scaffold to aid in the participants understanding of the course material. Perhaps further research can explore how AAC can be incorporated efficiently throughout the day (Binger & Light, 2007; Romski & Sevcik, 1996).

One study by Hindman et al., (2014) noted that the way a parent discusses the reading material impacts the child's literacy in language. Specifically, this study compared two types of talk. Code-related talk discusses the mechanics of reading. This includes letters and the sounds they make. Meaning-related talk focuses on the meaning of the words being read. Perhaps future research can look at code-related talk versus meaning-related talk while using AAC systems to augment the shared book reading experience. Possibly the type of talk during the shared book reading experience may impact the child's spoken language. Perhaps code-related talk might impact a child's literacy skills while meaning-related talk may impact a child's overall language development. It would be interesting to design a study to explore this further as it would potentially examine literacy and language development.

Conclusion

Although results are ambiguous due to some limitation in executing the study, at a minimum the results from this study, like earlier studies, show that AAC does not limit oral language production. This is important information because parents continue to face opposition to using AAC based on a misconception that it will hinder speech development. Additional research is needed to provide more conclusive evidence on the benefit of using AAC with children with limited oral language.

Many times, participants such as those in this study are denied an AAC system for fear that, since they are talking, the use of such a system would prevent them from speaking.

Furthermore, even when a system is provided it is not always appropriate. As school resources are limited, at times this can impact the type of AAC systems available to the participant. Furthermore, with limited AAC systems available, children who have some oral language may be low on the list of priority for access to such systems, as these systems may be prioritized for children with little to no oral language.

AAC systems can be used to augment the participants existing language and be a concrete example on how to structure language. Since most language is spoken and dynamic, it can be more difficult for participants such as in my study to grasp such fleeting and ever-changing concepts, as presented in spoken language. Having an AAC device literally allows the participant to experiment with how a sentence or thought might sound, and enables them to put words together. It also boosts comprehension as the adult models the use of the system and the participant can then repeat the information presented as needed multiple times (Binger & Light, 2007; Romski & Sevcik, 1996).

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Appendix

Table 16

LAMP 84 One Hit

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	Off	Right
My	Is	An	+s	Little	Bad	Said
I	Were	The		Up	Wear	Live
You	Was			Yes	Am	Love
They	On			Good	Please	Follow
It	to			Some	That	Ride
He				No	And	Put
She				Down	In	Not
				Out	What	Talk
				End	There	Sit
				New	Come	Eat
				Play	Time	Find
				Like	Do	Make
				Work	Go	Need
				Have	Get	Drink
				Feel	Big	Watch
				Read	Color	Turn
				More	Help	Sleep
				Fast	Look	Want
				Stop	Slow	Hear
				All	Think	

Table 17

Pets are Fun

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	Hamster	Little
My	Is	An		Down	Guinea pig	People
I	Were	The		Up	Dance	Animals
You	Was			Good	Play	Hear
They	On			Yes	Like	Think
It	to			Some	Has	Right
He				Many	Have	Said
She				No	Feel	Live
				Out	Read	Love
				Off	More	Put
				Bad	Pets	Red
				Lizard	Bunny	Blue
				Am	Want	Boy
				At	Look	Girl
				And	Come	Sit
				That	Time	Eat
				This	Do	Drink
				In	Go	Make
				What	Get	Need
				Dog	Big	Sleep
				Cat	Home	movies
				Pretty	Fun	

Table 18

Trains are Fun

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	Has	Right
My	Is	An	+s	Down	Have	Carry
I	Were	The		Up	Feel	Live
You	Was			Yes	Read	Love
They	On			Good	Trains	Put
It	to			Some	Food	Pull
He				No	Car	Blue
She				Far	Want	Boy
				Many	Look	Girl
				Things	Come	Sit
				Am	Time	Eat
				At	Do	Drink
				And	Go	Make
				This	Get	Need
				In	Big	Sleep
				Track	little	Fun
				Wheel	Engines	Yellow
				Long	People	Red
				Ride	Train	
				Play	Hear	
				like	Think	

Table 19

I like Mickey Mouse!

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Not
My	Is	An	+s	Mine	play	Talk
I	Were	The		Little	Like	Sit
You	Was			Up	Work	Eat
They	On			Yes	Have	Find
It	to			No	Has	Make
He				Some	Read	Need
She				Many	More	Drink
				Down	Donald_duck	Watch
				Out	Mickey_Mouse	Fun
				Off	Want	Clubhouse
				Bad	All	Big
				Wear	Come	Pluto
				Am	Time	Minnie Mouse
				Please	Do	Look
				That	Go	Slow
				And	Get	Hear
				In	Love	Think
				What	Follow	Right
				There	Friend	Said
				end	Goofy	live

Table 20

Colin, What Did You Do at School Today?

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Slow
My	Is	An	+s	Mine	play	Think
I	Were	The	-ed	With	Like	Not
You	Was			Up	Work	right
They	On			Yes	Have	Said
It	to			no	Feel	Live
He				Some	Read	snack
She				Down	More	Friend
				Out	Fast	Outside
				Off	Wait	Park
				Bad	Look	boy
				Wear	Want	Girl
				Am	Com	Sat
				Please	Time	Ate
				That	Do	Drink
				And	Went	Make
				In	Drove	Need
				What	Colored	Coffee
				There	Picture	Bus
				end	Colin	
				silly	school	

Table 21

Delicious Desserts

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Slow
My	Is	An	+s	Little	Play	Think
I	Were	The		Up	Like	Hear
You	Was			Yes	Work	Right
They	On			Good	Have	Said
It	to			Some	Feel	Read
He				Many	More	Love
She				Down	Stop	Forget
				No	Delicious	Cake
				Off	Dessert	One
				Bad	Come	Talk
				Wear	Want	Not
				Am	All	Sit
				Please	Time	Eat
				That	Do	Find
				And	Go	Make
				In	Big	For
				What	Get	Drink
				There	Candy	Share
				Ice Cream	Sizes	cookie
				Bite	Look	

Table 22

Amazing Pianos

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Slow
My	Is	An	+s	Little	play	Think
I	Were	The		Good	Like	Hear
You	Was			Up	Work	Right
They	On			Yes	Have	Said
It	to			No	Feel	Live
He				Some	Read	Love
She				Down	More	Follow
				Out	Dance	Use
				Off	Teenagers	Music
				Bad	Baby	People
				Wear	Want	Not
				Am	All	Sat
				Please	Time	Eat
				That	Do	Find
				And	Go	Make
				In	Read	Need
				What	Get	Drink
				There	Stop	Sing
				Amazing	Adult	Fun
				look	Piano	Keys

Table 23

Move

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Slow
My	Is	An	+s	Small	Play	Think
I	Were	The		Up	Like	Hear
You	Was			yes	Work	Right
They	On			Good	Have	Said
It	to			Some	Feel	Live
He				Many	Stop	Love
She				Down	More	Move
				No	Thing	Use
				Off	Wheel	Bicycle
				Bad	Come	People
				Wear	Want	Talk
				Am	All	Sit
				Please	Time	Eat
				That	Do	Find
				And	Go	Make
				In	Big	Need
				What	Get	Drink
				There	Read	Fly
				Fast	Train	Drive
				Car	Look	

Table 24

Daniel, What Did You Do at School Today?

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Slow
My	Is	An	+s	Mine	play	Think
I	Were	The	-ed	With	Like	Not
You	Was			Up	Work	right
They	On			Yes	Have	Said
It	to			no	Feel	Live
He				Some	Read	snack
She				Down	More	Friend
				Out	Fast	Outside
				Off	Wait	Park
				Bad	Look	boy
				Wear	Want	Girl
				Am	Come	Sat
				Please	Time	Ate
				That	Do	Drink
				And	Went	Make
				In	Drove	Need
				What	Colored	Coffee
				There	Picture	Bus
				end	Daniel	
				silly	school	

Table 25

Amazing Superheroes

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Batman
My	Is	An	+s	Little	play	Think
I	Were	The		Good	Like	Hear
You	Was			Up	Fly	Right
They	On			Yes	Have	Said
It	to			No	Wonder Woman	Superhero
He				Many	Spiderman	Superpower
She				Down	Fast	Help
				Out	Stop	Not
				Off	Want	Talk
				Bad	All	Sit
				Wear	Time	Eat
				Am	come	Find
				Please	Go	Make
				That	Climb	Drink
				And	Superman	Hulk
				In	Big	Amazing
				What	Flash	Smart
				There	Put	Strong
				End	People	
				look	can	

Table 26

Dinosaurs Lived Long Ago

Core Nouns	Core Verbs	Core Adjectives	Core Function words	Fringe words	Fringe words	Fringe words
Me	Are	Mine	A	Finished	New	Slow
My	Is	An	+s	Small	play	Think
I	Were	The	-ed	Good	Like	Hear
You	Was			Up	Work	Right
They	On			Yes	Have	Said
It	to			No	Feel	Live
He				Some	Read	Land
She				Down	More	Dinosaur
				Out	Stop	Grass
				Off	Want	Not
				Bad	All	Sit
				Wear	Time	Eat
				Am	Come	Meat
				Please	Do	Make
				That	Go	Need
				And	Walk	Sky
				In	Fly	Sea
				What	Big	Before
				There	Long	after
				Fast	Ago	
				Look	people	